cussed in a series of brief, extemporaneous talks.

L. T. Crook, F. L. Dye, J. J. Rose and W. B. Watson, engineers of the Panama Canal Special Engineering Division, collaborated on a paper which disclosed that total excavation for the Canal conversion project would require removal of 1,070,000,000 cu yd, 750,000,000 cu yd to be excavated in the dry, and 320,000,000 cu yd of wet material to be dredged.

Stressing the fact that the conversion in a single stage by deep dredging is preferable to stage dredging because "it would be cheaper, requiring a shorter construction period, and would interfere less with Canal traffic," the paper also highlighted the following:

Large shovels or draglines of 25-cu yd capacity would be used.

Wet excavation would be performed by conventional dredges supplemented by special hydraulic and bucket-ladder dredges capable of dredging to a depth of 145 ft below water surface, deeper than any ever known to have been operated.

The single-stage conversion would save five years of the construction period over stage-dredging methods studied.

Material removed in both the wet and dry excavating operations would be loaded directly into dump scows for disposal in Gatun Lake, and some of the material would be utilized in flood control construction necessitated by the conversion.

Net savings of the deep-dredging plan over stage dredging are estimated at $130,000,000.

Personnel required would be reduced by 9,000 workers through use of the prescribed methods, with resultant savings reflected in the lower cost of housing, utilities, services and mobilization.

Man-hours required for the ten-year project would total 307,910, beginning with 7,460 the first year, accelerating to 41,330 and 41,360 the next two years, and diminishing slightly in the subsequent years.

About two-thirds of the required manpower would be unskilled and largely indigenous to the Caribbean area. Contracts with skilled and technical personnel, to be obtained from the United States, would include payment of transportation from the place of recruitment and return, and transportation of government workers' families and household furnishings would be provided.

Cement, steel and lumber would be obtained from the United States.

Committee on Applied Mechanics Arranges Two Structural Division Sessions

TWO SESSIONS, for which the program was prepared under the direction of the Committee on Applied Mechanics, were held by the Structural Division, with E. L. Durkee, Bethlehem, Pa., chairman of the Division's Executive Committee, presiding.

At the first session Thursday morning, Alexander Hrennikoff, Assoc. M. ACSE, Associate Professor of Civil Engineering, University of British Columbia, Vancouver, B.C., presented a paper on "Framework Method and Its Technique for Solving Plane Stress Problems." A second paper was by Mario G. Salvadori, Assoc. M. ASCE, Assistant Professor of Civil Engineering, Columbia University, New York, on "Computation of Buckling Loads by Finite Differences."

Three papers also were presented at the second session Thursday afternoon. Henson K. Stephenson, M. ASCE, Associate Professor and Research Engineer, Civil Engineering Department, Agricultural and Mechanical College of Texas, had a paper, "Live Loads for Highway Bridges Based on the Chance Grouping of Heavy Trucks in Traffic." F. L. Shanley, consulting engineer, Los Angeles, Calif., had a paper, "Applied Column Theory." The third paper, "Design Criteria for Beams with Semi-Rigid Connections," was by Bruce G. Johnston, M. ASCE, Professor of Civil Engineering and Associate Director of the Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa., and Robert A. Hechtman, Assoc. M. ASCE, Research Engineer in Civil Engineering, University of Illinois.

Henson K. Stephenson

Professor Stephenson presented a paper in which he used the theory of probability as an approach to the solution of problems associated with the behavior of highway traffic. His paper dealt with the problem of vehicle grouping from a mathematical standpoint, "based on the same laws of chance or probability that have already been used successfully for solving many other types of engineering problems."

His paper covered "a variety of typical problems relating to vehicle grouping, which illustrate how the method may be used for estimating approximately how often various sequences or groups of vehicles might be expected to occur within given lengths of time or distances along the highway."

This method would be useful, he pointed out, not only in the construction of highway bridges, where economies can be effected in concrete and steel, but also in determining the need for warning or stop lights at highway and street intersections, or the timing of traffic lights at such intersections for the most efficient movement of traffic.

Professor Stephenson explained how he had divided traffic into three categories—light, heavy and medium—and sought to work out the most probable behavior pattern of traffic.

"Traffic is an every-changing flow of vehicles whose behavior is, at first glance, incapable of prediction by mathematical means," he said. "Yet, if at any given location, the most probable traffic pattern and the most probable average speed are established, the most probable behavior of traffic can be predicted by mathematical means. Although the type of analysis discussed herein has been applied to only a limited number of observed traffic data, the high degree of correlaton between the observed and calculated results obtained from these studies indicates that the behavior of highway traffic coincides rather closely with the assumptions upon which the mathematical procedures were developed."

He emphasized that the main objective of his paper is to develop a method rather than to decide on numerical conclusions, and said:

"A highway bridge, in order to perform its function safely, must not only be designed for the maximum stresses which may occur only once during its useful life, but also for varying numbers of repetitions of other stresses, less than the maximum, that might otherwise result in a fatigue failure if the design stresses are not properly reduced to provide for them, or if the various numbers of high stress repetitions are not estimated correctly and on the side of safety. It would be a relatively simple matter to determine the maximum stresses produced on a given

bridge by the heaviest types of individual trucks found on the highways. However, at the present time, no satisfactory method has been developed for estimating how often two or more of these heavy trucks, or combinations of these and lighter trucks, might be expected to occur on various parts or lengths of a bridge at the same time. And since both the maximum stresses, and varying numbers of repetitions of lower stresses that might result in fatigue failure, are practically all produced by heavy vehicle groups rather than by individual trucks, it is highly important that a satisfactory method be developed for estimating how often these events would be expected to occur as a result of any given or anticipated traffic conditions."

Lockless Canal Would Permit Transit of Vessels Now Barred by Size

IN ADDITION to helping to meet the threat of atomic bomb attack, conversion of the Panama Canal into a sea-level water route would assure adequate capacity for the rest of this century and permit "transit of any type of vessel of any size, including much larger naval vessels than now exist." This emphasis on capacity of the Canal, which was incapable of transiting some of the larger naval vessels built or remodeled during World War II, marked the three symposium papers presented before the Waterways Division. W. W. De Berard, Chicago, chairman of the Division's Executive Committee, presided. C. A. Lee and C. E. Bowers, hydraulic engineers at the Navy's David Taylor Model Basin in Washington, D.C., collaborated on one, "Investigation of Ship Performance in Restricted Channels," detailing their model studies. J. E. Reeves and E. H. Bourquard, respectively the chief of division and chief of navigation section, Special Engineering Division, Panama Canal, co-authored another, "Design of Channel for a Sea-Level Canal," describing design methods for the proposed canal. The third paper, "Traffic and Capacity of the Panama Canal," by Ralph P. Johnson, Corps of Engineers, Little Rock, Ark., who formerly was chief of the route studies and reports branch of the Special Engineering Division, and Sydney O. Steinborn, engineer in charge of the Special Engineering Division's traffic studies, reported:

"In the year 2000, the average daily traffic would be 46 vessels; the peak-day traffic for which the canal should be designed is 69 vessels. By about 1960, the capacity of the present canal, during periods of lock overhaul, would be insufficient to accommodate traffic without undesirable delays on peak days."

While asserting that "with modifications, principally to eliminate the periodic need for closure of one of the twin locks for overhaul, the capacity or the present canal could be increased to meet all commercial requirements until the end of this century," the paper emphasized that "certain large naval and commercial vessels would be unable to transit the Canal," and only "the construction of new and larger locks or the conversion of the present canal to sea level would create sufficient capacity to handle all traffic until well beyond the year 2000."

It was brought out that a lock canal designed to meet the future needs of commerce and having the maximum security feasible in this type of canal would cost $2,307,686,000, but would still be deficient in resistance to modern weapons.

As depicted in the papers presented at the Waterways Division session, the sea-level canal would permit not only transit of vessels of any size likely to be built during the remainder of this century, but would permit two-way passage of vessels. Such passage would be possible in fog, which has been a severe handicap in the present canal.

Good Engineering Credited with Holding Down Mounting Power Production Costs

THE POWER DIVISION held two sessions, Friday morning and Friday afternoon, with Joel D. Justin, Philadelphia, chairman of the Division's Executive Committee presiding. The morning session was devoted to hearing two papers on cost trends in steam-electric and hydroelectric power generation. Edwin H. Krieg, consulting mechanical engineer, American Gas and Electric Corp., New York, and Milton G. Salzman, civil engineer, Ebasco Services, Inc., also of New York, prepared papers on cost trends at the morning session.

At the afternoon meeting James P. Growden, chief hydraulic engineer, Aluminum Co. of America, Pittsburgh, authored a paper, "The Nantahala Earth-Faced Rock-Fill Dam"; Donald J. Bleifuss, engineer with the Morrison-Knudsen Co., Inc., San Francisco, had a paper on "Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development," and Raymond E. Davis, director, Engineering Materials Laboratory, University of California, Berkeley, had a paper on "Rehabilitation of Barker Dam." See page 26.

Edwin H. Krieg

Mr. Krieg's paper, which discussed engineering methods of holding down initial and operating costs, summarized cost trends in steam-electric power generation as follows:

"Large increases in steam-electric plant investment and in cost of generating electricity by steam turbine-generators have followed World War II. Not only do cost indexes show that steam-electric plant costs have already increased some 63 percent, but operating costs have risen about 51 percent through increased fuel costs and higher wages for plant operators.

"Increased investment and operating costs can only be partly compensated for by reducing the controllable elements of investment and operating costs, and some examples of each are given.

"Briefly, the matter of cost of generating electricity stands:

"1. System investment costs have gone up some 57 percent.

"2. Operating costs have gone up some 51 percent.

"3. Taxes are almost 20 percent of gross operating revenue and approximate 1.5 times the fuel bill.

"4. Higher costs are likely to continue for some time, which means

materially lower earnings for utility companies. Reserve capacity to cover outages or unavailability of equipment is at an all-time low. This additional needed capacity and replacement of obsolete capacity must be made at current high costs. Such additional plant can only mean less output per kwhr and hence less earnings per dollar of investment for the new facilities.

"Present high costs make this a time, not for traditional rate reductions, but rather for the expending of all energy to make both ends meet with present tariffs. It is a time to follow costs closely for their effect on long-term planning and earnings. What will total earnings be five or ten years from now when the revenue on a $1,600 capital investment will only be that formerly received from $1,000.

"Cost of electricity has not increased in spite of rises in every component for producing it, but rather has helped to keep the price structure stabilized by contributing not a whit to the ascending spiral of prices. While this has been true in the past, it may not be possible to so continue in the face of unceasing pressure of price rises in other commodities. It may be necessary also to increase the price of electricity."

Milton G. Salzman

An 80 percent increase in the productivity of workers in privately owned electric light and power utilities, as against productivity of common and skilled labor which a recent survey found to be 36 percent under prewar standards, is a key factor in checking the rising trend of operating costs in hydroelectric plants, Mr. Salzman's paper stated. He discussed engineering techniques which he credited with helping to offset the rising trend of labor and materials cost in construction of hydroelectric plants.

"Efficiency in design, construction and operation of new hydro plants must of necessity be the keynote if costs of generation are to be kept in bounds," he said.

Pointing out that the stepped-up postwar tempo of the nation's business has created a "dire necessity of obtaining the most readily available source of plant capacity to keep pace with the rapid and abnormal load growth on most power systems," Mr. Salzman listed labor and material prices as the principal uncontrollable items affecting both investment and production costs, and added, "There is no recourse but to accept the prevailing prices, as plants must be built and operated when needed."

Engineering matters, which he listed among controllable costs, are plant location, size of installation, number and type of units, plant layout, selection and suitability of equipment.

Threat of coal and transportation strikes to curtail steam production of electric power has given development of hydroelectric projects a new impetus, Mr. Salzman said, and sites which were formerly considered uneconomical, when compared to steam, are again being reviewed.

As an example of economies effected by skillful engineering, simplified and improved design and coordinated layout together with improved efficiency and increased output of plants, Mr. Salzman cited a recent extension to a hydro station in the Northwest. Through installation of an addition to the plant at a cost of about $58 per kw, the overall unit investment cost of the plant will be reduced from $148 to $103 per kw, he said.

Sea-Level Flood and Tidal Hazards Can Be Overcome, Hydraulicians Report

FLOODS AND TIDAL currents, deemed momentous hazards to shipping when a sea-level Panama Canal was considered early in the 20th century, can be rendered harmless by modern engineering if the proposal before Congress to convert the present lock-and-dam canal to a sea-level route is adopted as a means of meeting the threat of atomic-bomb attack.

Details of the hydraulic techniques involved were discussed before the Hydraulics Division of ASCE at one of two sessions held by that Division, by engineers authorized by Congress to make a postwar study of "means for increasing the capacity and security" of the Canal. They participated in a symposium on the Panama Canal, which was the theme of the meeting. Presiding at both meetings was Dr. Lorenz G. Straub, Minneapolis, chairman of the Division's Executive Committee.

Presenting papers were F. Steward Brown, Assoc. M. ASCE, of the Panama Canal Special Engineering Division, on "Flood Control for a Panama Sea-Level Canal," and Stuart Meyers and E. A. Schultz, both Associate Members ASCE, also of the Special Engineering Division, who collaborated on "Tidal Currents in a Panama Sea-Level Canal."

A plan of control was outlined by Mr. Brown "wherein 87 percent of the tributary area would be diverted directly to the Atlantic Ocean and an additional 4 percent would be controlled by retarding reservoirs."

"The control of floods on the tributaries would completely eliminate hazards to shipping from flood inflows and resultant cross currents," Mr. Brown said. "The system would have sufficient capacity to control flows well in excess of the largest flood that has occurred in 47 years of record."

Such dams as would be required for creating retarding reservoirs, he said, "would be virtually unbreachable by bombing of any type, and a breach in the levees would be of no consequence."

If breached, he said in contrasting damage that would result from bombing of the present lock-and-dam arrangement, "only minor remedial work would be needed to restore the system to effective operation."

In their paper, Messrs. Meyers and Schultz described the hydraulic model of the sea-level canal they used in part of their studies, at 1 to 100 undistorted scale, and discussed measurements of roughness utilized by them. They estimated a current of "about 4.5 knots, at the Atlantic end of the Canal, as the maximum that would be caused in an open sea-level canal by a tidal range of 20 ft in the Pacific Ocean," as against 2 ft in the Atlantic.

The second Hydraulics Division session consisted of a symposium on High-Velocity Flow in Open Channels, in which three papers were read. Arthur T. Ippen, Assoc. M. ASCE, Associate Professor of Hydraulics, Massachusetts Institute of Technology, Cambridge, Mass., presented a paper on "Supercritical Flow in Open-Channel Contractions." Robert T. Knapp, M. ASCE, Professor of Hydraulic Engineering, California Institute of Technology, Pasadena, had a paper on "Design of High-Velocity Curves." The third paper, "Open-Channel Expansions for Supercritical Flow," was by Hunter Rouse M. ASCE, Director, Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City.

Pros and Cons of Toll Roads Discussed at Highway Division Meeting

"TOLL ROADS" were the subject of a panel discussion which occupied the entire session held by the Highway Division Friday morning. Presiding was Charles M. Upham, Washington, D.C., chairman of the Division's Executive Committee.

Papers were presented by Enoch R. Needles, M. ASCE, Consulting Engineer, Howard, Needles, Tammen and Bergendoff, New York, and H. S. Fairbank, Deputy Commissioner, Public Roads Administration, Washington, D.C. Panel leaders in the discussion were Joseph Barnett, Chief, Urban Road Division, Public Roads Administration; Charles M. Noble, New Jersey State Highway Engineer, Trenton; Walter H. Steel of New York, a partner in the Phiadelphia banking firm of Drexel and Co.; and R. E. Jorgensen, Deputy Commissioner and Chief Engineer, Connecticut State Highway Department.

Enoch R. Needles

Citing as notable examples of toll roads the George Washington Bridge, the Holland Tunnel, the Lincoln Tunnel, the Triborough Bridge and the Henry Hudson Parkway, among others, Mr. Needles said:

"There may be reason to question the wisdom of building a specific project as a toll project, but it is hoped that no engineer will propose that these bridges, tunnels and parkways or highways should not have been built as 'free' projects, since it is so clear that many of these major facilities would have been delayed indefinitely if they had had to await construction as 'free' projects. The service these facilities have provided in the New York Metropolitan area is almost beyond measure, and the indirect benefits to the community are undoubtedly the equivalent of the direct.

"The toll road or bridge or tunnel should be considered as a device for providing special transportation service under special conditions through payment of a special tax or toll. The collection of tolls in payment for special service or unusual accommodations in travel or transportation is not new, nor has the toll been considered an unfair or improper form of tax if the toll is clearly reasonable and the service wholly adequate and desirable but unattainable except on a special tax basis. No tax has ever been popular. There is no perfect tax. There have always been different theories on taxation. Recently, a very practical politician told me that the ideal tax was that tax which would produce the greatest return to the collector with least complaint from the public. As a taxpayer, I must confess that I want my taxpaying as painless as possible, whatev the device which lulls me to compla cency.

"Now a toll is a tax. So no toll ever popular. It is endured only a the service provided is clearly wort the fee collected, and as it is equall clear that an equivalent 'free' facilit could not have been possible unde any reasonable conception. Actuall there is no such thing as a tax-free o a toll-free road. We all know this t be true. But we speak of the 'free road or the 'free bridge' as the one fo which no *direct* service charge is col lected as we travel over it.

"Fundamentally, our city street are 'free.' But how free are the when restrictions begin to appear i behalf of 'the greater good to th greater number'? One-way streets no trucking, slow, no parking—are these signs of 'freedom,' or simply de vices for better service to the genera public? The parking problem is no so universally complicated and bur densome that any arrangement which will take cars off the streets but pro vide convenient public parking for a modest toll is hailed as a notable ste forward in municipal planning and administration.

"No toll highways should be built unless a comparable 'free' highway is clearly unattainable and unless it can be demonstrated to be self-support ing by competent authority. All toll highways should be publicly owned and should become 'free' and part of our state highway systems when they have paid for themselves."

Canal Slide Dangers Can Be Minimized, Soils Experts Report

DANGER FROM SLIDES, bane of construction and early operation days of the Panama Canal, can be minimized by modern engineering in the proposed conversion of the present lock-and-dam canal to a sea-level route virtually impregnable even to atomic bombing. In fact, special slope-design treatment, evolved in studies which included causes of slides so great that they closed the present canal to traffic as recently as 1931, can produce slopes which not only would be stable under static loading, but which would resist dynamic forces so effectively that "large explosions would not be expected to cause closure of the canal."

This was the gist of papers read before the Society's Soil Mechanics and Foundations Division by W. V. Binger, chief, Soils and Geology Branch, Missouri River Division, Corps of Engineers, Omaha, Nebr., formerly chief of the Soils and Foundations Section of the Panama Canal, and Thomas F. Thompson, chief of the Geology Section, The Panama Canal, who had a joint paper on "Excavation Slopes for an Improved Panama Canal"; and Dr. Arthur Casagrande and W. L. Shannon of Harvard University who, under contract with the special engineering committee of the Panama Canal, conducted tests of strength of soils under dynamic loads. The Harvard men collaborated on a paper describing their work on this project. Frank A. Marston, Boston, chairman of the Division's Executive Committee, presided at the session.

The papers pointed out that, although more than one billion cu yd of excavation will be required—about three times the volume of material removed in construction of the existing canal—slopes can be designed that would be secure from major slides such as those which earlier spasmodically closed the canal for several months at a time.

Dr. Casagrande and Mr. Shannon described apparatus developed and tests performed to investigate the strength of soils and soft rocks under dynamic loads and concluded: "From the tests performed on soils it can be concluded that their strength under transient loading is greater than their strength under static loading."

In their paper, Messrs. Binger and Thompson asserted that although the effects of large bomb explosions were

not taken into account in the development of slope-design standards, the Harvard University studies indicate that "sliding failures caused by dynamic loads on a statically safe slope would probably not result in closure of the canal, and flattening the slopes beyond the requirements for static stability, therefore, is not believed to be necessary."

The Soil Mechanics and Foundations Division had a second session, a joint meeting with the Air Transport Division, the program for which was arranged by the Committee on Airfield Foundations.

At this meeting of the two Divisions two papers were presented, one by Robert R. Philippe, Assoc. M. ASCE, Head Engineer, Ohio River Division Laboratories, Department of the Army, Corps of Engineers, Mariemont, Ohio, on "Full-Scale Research on the Design of Concrete Pavements and Their Foundations," and another by O. J. Porter, M. ASCE, consulting engineer, Sacramento, Calif., on "Vertical Sand Drains for Stabilization of Compressible Foundations."

Robert R. Philippe

Increasingly heavier aircraft make structural analysis essential in fixing the design of heavy-duty landing-field pavements in the interest of safety, Mr. Philippe said in a progress report on the investigations of rigid pavements that have been under way by the Corps of Engineers since October 1941.

"In the late thirties," Mr. Philippe said, "most highway and airport pavements were designed and selected without much regard to structural analysis. Experience indicated this procedure to be correct because wheel loads had not exceeded 15,000 lb, and the minimum thickness required for construction and durability satisfied many of the observations and attempted correlations. Conclusions drawn prior to this time are clouded by this basic condition."

Pointing out that some operators of airports have been inclined to minimize the importance of structural analysis advocated by engineers, Mr. Philippe asserted that the evidence gathered by the Corps of Engineers' study "indicates the need of structural analysis to fix the design of heavy-duty pavements." A more detailed account of Mr. Philippe's paper is presented in the article entitled, "Full-Scale Research Advances Design of Rigid Pavements for Heavy Wheel Loads," on page 32 of this issue.

Two Symposiums Are Conducted by Sanitary Engineering Division

TWO SYMPOSIUMS were conducted by the Sanitary Engineering Division, one Thursday morning and the other Thursday afternoon, with Dean Gordon M. Fair, of Harvard, chairman of the Division's Executive Committee, presiding. At the morning session, the symposium subject was "Operations of Authorities Concerned with the Sanitation of Rivers and Harbors." Participating were Warren J. Scott, M. ASCE, Director of the Bureau of Sanitary Engineering, Connecticut Department of Health, Hartford; Arthur D. Weston, M. ASCE, Director and Chief Engineer, Massachusetts Department of Health, Boston; Seth G. Hess, M. ASCE, Director and Chief Engineer, Interstate Sanitation Commission, New York; James H. Allen, M. ASCE, Executive Secretary, Interstate Commission on the Delaware River Basin, Philadelphia; and Robert N. Clark, M. ASCE, Chief Public Health Engineer, Tennessee Valley Authority, Chattanooga.

In their papers, these authors described the cooperative efforts of the various states and the federal government to control pollution in interstate streams. Emphasis was placed on the need for states to undertake sanitation work in cooperation with neighboring states.

Importance of local participation and cooperation was stressed in all the papers, including that presented by Mr. Clark, which concluded:

"There is a need to strengthen every component of state and local government, every local or regional industrial organization, every consulting engineer, who is attempting to reduce pollution. It does not strengthen any group for a federal agency to take over its functions. The more practical way is to facilitate a record of successful accomplishment, to build prestige, to bring to bear correlative groups or activities, and finally, as the local service is established, for the federal agency to withdraw as completely as possible, leaving a small organization adapted to meet its own situations and representing the people of the region."

The afternoon symposium, on "Sewage Disposal into Tidal Rivers and Estuaries," was comprised of papers by Karl R. Kennison, M. ASCE, Chief Engineer, Metropolitan District Commission, Commonwealth of Massachusetts, Boston; Richard H. Gould, M. ASCE, Director, Division of Engineering, Department of Public Works, New York; and a joint paper by Samuel S. Baxter, M. ASCE, and M. B. Tark, M. ASCE, who are, respectively, Assistant Chief Engineer and Associate Engineer of Design of the Philadelphia Public Works Department's Bureau of Engineering Surveys and Zones.

Richard H. Gould

New York's "other urgent needs" are holding up a $134,000,000 sewage treatment program, needed to cleanse waterways surrounding the city and to provide safe health conditions for bathing and other recreation, Mr. Gould asserted in his paper, read in his absence by Dr. Gail P. Edwards, of the New York City Department of Public Works. The city's program, already delayed by the war, makes "construction of additional major plants contingent on the ability of the city to provide funds in the face of other urgent needs and under statutory limitations that are now quite restrictive," the paper stated.

"The possibilities of financing the sewage work by special sewage charges has been seriously considered, but there appears to be no immediate prospect of early adoption of this method," Mr. Gould said.

Listing eight plants for which design is from 6 to 100 per cent complete, he said:

"Construction has been resumed on the 60 mgd 26th Ward Plant in Brooklyn, and bids are now being advertised for the first contract of the 160-mgd Owls Head plant, also in Brooklyn. Plans and specifications, in completed or partly completed stage, are available for construction work to the value of about $80,000,000."

Pointing out that while sewage treatment in what is now New York City started some 63 years ago, the program for modern plants started only 13 years ago, Mr. Gould' paper concluded:

"While there is still much to be done in New York and there are still many serious conditions to be corrected, the works now operating have done much to alleviate conditions in some areas and have permitted the advancement of many other worthwhile public improvements. It is believed that the city is becoming ever more conscious of the necessity of carrying on to completion the work of furnishing treatment to all sewage originating in the city."

The plants listed by Mr. Gould, together with their capacities, expressed in million gallons daily, are: Hunts Point, 120; Rockaway, 15; Owls Head, 160; Newtown Creek, 280; Port Richmond, 10; Wards Island Extension, 240; Bowery Bay Extension, 80; Oakwood Beach, 15; Red Hook, 40; Tottenville, 3; Fresh Kills, 5, and Bloomfield, 3.

Samuel S. Baxter and M. B. Tark

Progress in Philadelphia's 30-year sewage disposal battle was reported in this jointly prepared paper. Pointing out that prior to 1918 all of the sanitary and storm sewage of Philadelphia's 253-sq mile area was discharged into the Delaware and Schuylkill Rivers without treatment, the Philadelphians discussed the Northeast Works which now gives primary treatment to about 60 mgd, approximately 19 percent of the average dry-weather flow.

They listed as under way the following additions to plant: primary, aeration, and final sedimentation tanks, sludge digestion tanks and a water tank, together with mechanical equipment and electrical and pumping work for these facilities.

"Total work under contract at this time amounts to $7,000,000," the paper asserted. "Work started on May 5, 1947, and is proceeding slightly ahead of schedule. Contracts for the blower building and for miscellaneous work will be advertised in 1948. Present schedule calls for the plant to go into operation on September 1, 1949.

"Sites for two other treatment plants, the Southeast Works and the Southwest Works, have been acquired, and a pumping station has been built at the Southwest Works. Some of the intercepting sewers to serve these plants have been constructed, but no treatment facilities have been started. It is now planned to begin construction on these plants in 1949."

Clinical Analysis of Urban Growth Marks Meeting of City Planners

A CLINICAL ANALYSIS of urban growth occupied the attention of the City Planning Division at its session Friday afternoon. With Lawrence Sheridan, Indianapolis, member of the Division's Executive Committee, presiding and making the introductory remarks, four speakers participated in the analysis which preceded a general discussion.

The only woman on the Annual Meeting program, and one of the few ever to appear before the ASCE, was the first speaker at this session. She is Mabel L. Walker, Executive Director, Tax Institute, New York, who spoke on "What Are the Forces Determining Metropolitan Patterns?" Other speakers were: Robert F. Wagner, Jr., chairman, New York Planning Commission, whose subject was "Can Urban Redevelopment Save Our Cities?"; Hugh R. Pomeroy, director, Westchester County Planning Commission, White Plains, N. Y., who discussed "What Form Shall Urban Expansion Take?"; and Leslie Williams, New York consulting engineer and secretary of the ASCE City Planning Division's Executive Committee, who concluded the program by discussing "The Need for Comprehensive Planning."

Mabel L. Walker

City planners must plan the city for the people, and not the people for the city, Miss Walker said. "The individual is no longer a building block, as circumstances forced him to be during the 19th century when the hard economic facts of life forced more and more people to the city because that was where they could earn a living. The individual is the ultimate architect of the city. The decisions he makes as an individual, coupled with those he makes with his neighbors, will determine the city pattern of the future. The specialist can merely tag along, providing the technical know-how for the individual."

Miss Walker pointed out that transportation facilities largely determined the locations of cities in the first place, and attracted industries which, in turn, attracted the people.

"But he who giveth can also take away. Transportation helped to build our cities during the 19th century; transportation is helping to break them up during the 20th century. We are going to be forced to reconvert our cities, not because we think it will attract population and enhance land values, but because we need cities that are functionally adapted to the time in which we live."

Citing statistics showing population decline in cities, with largest decline in the larger cities, Miss Walker warned that this trend is no transitory matter. "There seems every likelihood," she said, "that this decentralization will proceed at a rapidly accelerating rate for at least a few decades when, perhaps, some approximate stability may be achieved, but at a far lower density than at present."

Scoring "experts who demand rather apoplectically whether we are going to permit the cities to empty out," Miss Walker asserted:

"Not permit, but help them decentralize, may be the appropriate reply. We shall be defeated if we try merely to patch up the cities along the lines of their present pattern. We must soberly evaluate past trends and future possibilities, and free our minds for a new approach. We cannot stop this outward flow. We can either impede it, and thereby make conditions in and around the city intolerable for a generation or so, or we can consciously and deliberately smooth the way for the decentralization to take place, realizing full well that we are to be temporarily accelerating it, but that by so doing, we shall make the inevitable adjustment more smoothly and more quickly."

Miss Walker depicted the city of the future as a fluid city, if properly planned, stating:

"Any way we look at it, traffic conditions are likely to be almost intolerable for the next decade or so, but if population trends are reasonably well appraised and transportation facilities developed commensurate to the need, we should evolve a much happier urban-rural pattern after a few years. If the city of the future is to have health and vitality, it must be possible for these great human tides to flow in and out easily and readily. The fluid city of the future will not be less expensive to maintain than the static city of the past. During the transitional years it will be far more expensive, because these old cities must be loosened up at their stiff old joints and elasticized in their hardened old arteries, and that is probably going to be a more costly process than building them in the first place."

Robert F. Wagner, Jr.

Urban redevelopment, to restore blighted areas, decrease juvenile delinquency and provide better health conditions, is a major task which "necessarily calls for an even greater degree of cooperation between private industry and government at all levels," Mr. Wagner declared.

Citing a slum clearance survey made by his U.S. Senator father, Mr. Wagner said preliminary results "shed additional light on the need for greater activity, particularly on the part of government, in the field of urban redevelopment."

Speaking of the questionnaire sent to governors of all states, mayors of cities with populations of 50,000 or more, and prominent individuals representative of the nation's business, civic and social life, Mr. Wagner said:

"There was virtually unanimous agreement among these persons as to the widespread existence of slums and blighted areas. Approximately 90 percent of those replying stated that private enterprise could not now, or in the foreseeable future, provide decent housing for the low-income families residing in the slums. Dissents from that position were few among all groups, including those directly connected with private home building and finance. An equally high percentage favored publicly assisted low-rent housing for families who cannot afford decent private housing.

"The mayors who replied to the questionnaire reported that low-income families have benefited greatly by the housing program and that it has operated efficiently. There is likewise agreement among them that as a result of the housing program, conditions of health and juvenile delinquency have been improved, and that publicly financed housing did not prove competitive with standard private housing. A large majority of the mayors reported that the costs of city services in the areas have been reduced and the neighboring real estate values increased as a result of these projects.

"In addition, there was widespread agreement as to the desirability of a program for clearance of slums and blighted areas, and for the redevelopment of cleared sites, privately or publicly, in accordance with community plans. In general, replies sounded a prevailing note of urgency for prompt and effective action by Congress to meet the housing shortage.

"However, the problem of redevelopment is not limited entirely to housing, although that is its most pressing manifestation. Urban planning necessarily involves consideration of every phase of urban living—trade and commerce, traffic and transit, industrial location, highways, parks, and schools, and, of course, the financial ability of the city to provide the necessary municipal facilities."

Mr. Wagner pointed out that, bearing in mind that dispersion of industry, as a defense measure against atomic attack, can be expected to contribute to the mass exodus from dense population centers which has been in progress in this country for some years, "we face today a new challenge and a new opportunity to uproot from the cities the slums and blight which have marred their development."

Engineering Administration of Marshall Plan Urged in Address by W. L. Batt

ENGINEERING ADMINISTRATION of the Marshall Plan to keep it unfettered by "the cheap and tawdry shackles of political bias" was advocated by William L. Batt, wartime vice-chairman of the War Production Board, in an address at the opening-day luncheon of the Annual Meeting.

"If the job of rehabilitating and modernizing European industry to the point where it can again produce is to be done, the engineer, and not the politician, must do it, for the engineer is not concerned with being reelected but with efficiency and results," Mr. Batt said.

Mr. Batt, who has been President of SKF Industries, Inc., Philadelphia, for 25 years and spent six years in wartime service in Washington, called upon industries to lend engineers and production experts to the administrators of the European Recovery Program for duty abroad, and even "continue to pay their salaries." Mr. Batt is a member of the Department of State's Business Advisory Council, President Truman's Committee on Voluntary Foreign Aid, and Chairman of the Allocations Committee of American Overseas Aid. He has visited Europe four times in the last two years, twice on official missions.

Citing voluntary individual gifts to Europe since the end of World War II as "reliable indications that the American people favor aid to Europe with their hearts as well as their minds," Mr. Batt said all the evidence points toward a continuation of this private relief to Europe. Calling the bipartisan nature of the United States foregin policy one of its major bulwarks and complimenting responsible leaders of both parties for their efforts to maintain a united approach to major world problems, Mr. Batt warned:

"But now there is a most disquieting clamor even in this most partisan of political years. Some very vocal people are attempting not only to inject partisan politics into the consideration of very grave questions of foreign policy; they are also trying to tie political strings onto the whole European recovery program. Men in responsible positions, who should know better, have said that they would like to see us use the Marshall Plan as a bludgeon to club European nations into changing their forms of government or making sweeping changes in their governmental procedures.

"They share the distrust and distaste which most Americans fortunately have for forms of government based on varying degrees of state control of the individual. They forget, however, that nothing has so annoyed the men in the Kremlin as the Marshall Plan. The Communists opened the floodgates of their vast propaganda when the plan was first broached by Mr. Marshall at Harvard. They have reconstituted the Comintern and set up a special propaganda bureau to combat it. Their predominant theme is that the whole Marshall Plan is, in their nomenclature, 'a devilish and clever plot by the imperialist United States to usurp the sovereignty of European nations and to take over and control every country that participates in the plan.' To tie political strings to the Marshall Plan would simply be adding another loud instrument to this symphony of calculated discord."

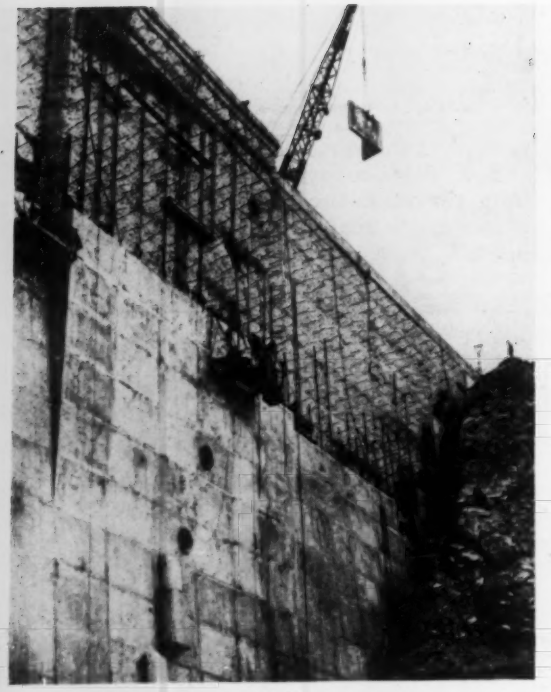
Calling the American engineer "the personification of what is referred to and admired around the world as 'American productive genius' or 'American know-how,'" Mr. Batt asserted:

"Whereas the ordinary run of American politician will inspire distrust when he attempts to guide the destinies of other nations, the American engineer is more fortunately regarded. His skill and knowledge are universally praised. The fact that our nation's political development has lagged far behind its economic growth proves this point and is at once apparent to the European.

"That is why I want to make a proposal to you engineers and, through you, to the diverse and important enterprises you represent.

"I believe that the heads of industries can benefit their own organiza-

(*Continued on page 86*)



LIGHT TRAVELING SCAFFOLDS facilitate work of taping and grouting joints of precast slabs erected as forms for protective blanket of concrete on face of Barker Dam. Two new 30-in.-dia hydraulically operated gates (near bottom of photo) and openings through slabs to which additional 30-in.-dia gates will be attached are part of gate-block construction. Crane lowers L-shaped slab for corner of gate-block section.

Grouted Gravel Fill and Precast Slabs Provide New Face for Barker Dam

RAYMOND E. DAVIS, M. ASCE, E. CLINTON JANSEN, M. ASCE., and W. T. NEELANDS

REHABILITATION OF THE badly disintegrated upstream face of Barker Dam, a 38-year-old, 175-ft-high concrete structure in Boulder County, Colo., involved the use of precast concrete slabs as forms in constructing a protective blanket of concrete varying in thickness from about 3 ft at the crest to about 8 ft at the base. The work was performed by the Prepakt Concrete Co. under terms of a contract with the Public Service Co. of Colorado. John Hofer was superintendent of construction. Engineering representatives of the Public Service Co. were E. Clinton Jansen, M. ASCE, hydraulic engineer, and L. B. Card, mechanical engineer. The plans and specifications were prepared by Raymond E. Davis, M. ASCE, consulting engineer and director of the Engineering Materials Laboratory, University of California, Berkeley. W. T. Neelands acted as resident engineer. Data presented herein, including techniques used in casting and erecting of precast slabs, the use of Prepakt concrete, grouting procedures, and comments on the insignificant form pressures and low temperatures observed, are abstracted from a paper presented before the Power Division at the ASCE Annual Meeting.

BARKER DAM, completed in 1910, is a gravity structure of cyclopean concrete having a maximum height of about 175 ft and a crest length of 720 ft. Its original volume was about 135,000 cu yd and its maximum thickness 124 ft. Located at an elevation of 8,200 ft, 17 miles west of Boulder, Colo., and about 20 miles east of the summit of the Rocky Mountains, the structure creates Barker Reservoir, which has a storage capacity of about 12,000 acre-ft. This water is the source of supply for the Boulder hydroplant, 12 miles downstream from the dam.

The reservoir is filled principally by the waters from melting snows during the spring and early summer, and is drawn down until it is nearly empty during the late winter and early spring, when the runoff of the drainage area is only a few second-feet. Because of the annual drawdown during the cold months, the upstream face was subjected to very severe conditions of freezing and thawing which, after 36 years, caused pronounced disintegration of the concrete at and near this face.

Originally the foundations were not grouted. Although the specifications provided for the possibility of foundation drainage by 2-ft-deep drill-holes at seams in the foundation rock, it can be assumed that only a very few such drains were actually installed.

After the dam was placed in service, pronounced leakage was observed through the foundation rock and there was considerable leakage through contraction joints which were without water stops. Also seepage occurred through horizontal construction joints. About 15 years ago an attempt was made to stop leakage by grouting through drill-holes in the abutment rock and in the dam itself, but a few years after the grouting was done, the leakage again became very pronounced. This condition pointed to the probability of the existence of large uplift pressures, not considered in the original design. For a full reservoir, considering uplift, analysis disclosed that according to our modern theories of design the dam was lacking in stability.

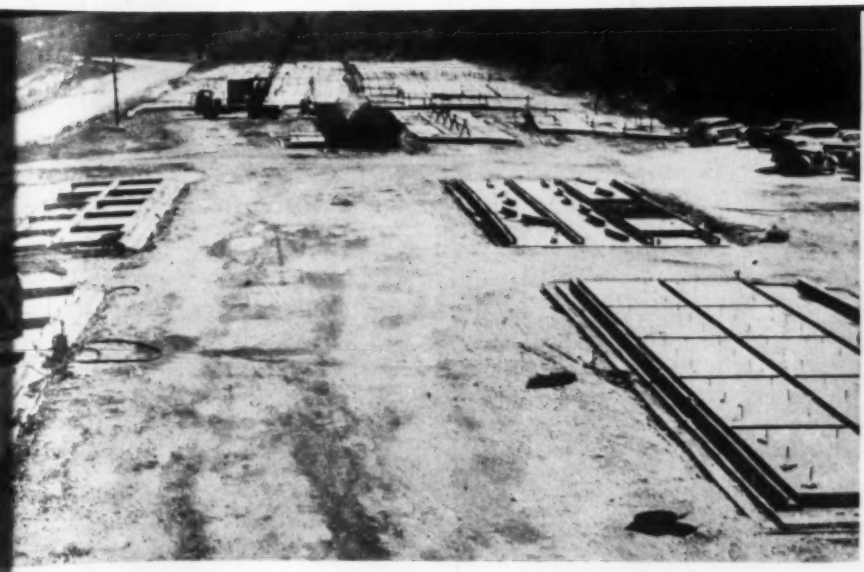
AS PART OF the Boulder Hydro Development, Barker Dam was constructed during the years 1908 to 1910 by the Eastern Colorado Power Co., a predecessor in interest of the Colorado Power Co. As a high-head peak plant, it forms today a valuable unit in what is known as the Central System of the Public Service Co. of Colorado. The hydro project is located in the canyon of Middle Boulder and Boulder Creeks in Boulder County, Colorado. Barker Dam is on Middle Boulder Creek. The capacity of Barker Reservoir is about 5,800 day-sec-ft, or about 15,000,000 kwhr at the powerhouse.

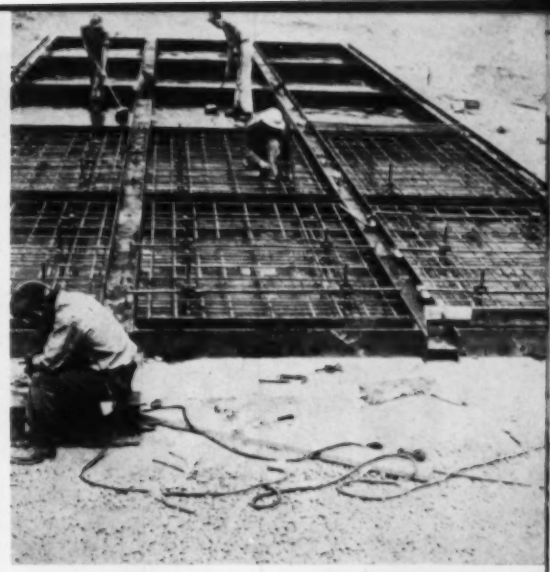
Rehabilitation Program

The work of rehabilitation consisted of deep and shallow foundation grouting at and near the upstream face of the old dam, the removal of all defective concrete from the upstream face of the dam, the addition to this face of a blanket of new concrete varying in thickness from about 3 ft at the crest to about 8 ft at the base, and the installation of a drainage system, composed of deep foundation drains and contraction-joint drains connected to a longitudinal drain within the addition to the upstream face. Two branches of the main longitudinal drain terminated at a transverse drainage tunnel cut through the base of the dam.

The unique features of the work are considered to be the drainage system and the methods employed in making the addition to the upstream face.

The addition was constructed by (1) erecting precast reinforced concrete slabs to act as forms over the entire upstream face, which slabs became a part of the permanent struc-





CASTING YARD (above, left) with 60-unit capacity produces 1,009 slabs needed in rehabilitation program. Slabs are moist cured for 14-day period and placed in storage yard seen in background of photo. Close-up view of concrete base (above, right) shows side forms in position and prefabricated mats of reinforcing bars in place. Steel dowels in downstream sides of slabs are later welded to anchor bars in face of dam. Base is mopped with oil (background) before concrete is poured. Water pressure applied beneath 4-ton slabs prevents formation of vacuum and aids lifting operation.

ture, (2) filling the space between these slabs and the upstream face with coarse aggregate, and (3) when the reservoir was nearly filled, grouting the mass of coarse aggregate from the bottom to the top as a continuous operation.

Materials

The aggregates for both Prepakt and conventional concrete were processed from a deposit of sand and gravel about three miles upstream from the dam. For Prepakt concrete the sand was 0 to No. 16 and the coarse aggregate was $^5/_8$ to $4^1/_2$ in. Type II portland cement was specified for all the work. Alfesil, which is the trade name for a very finely divided siliceous material, was employed in all grout mixes for both foundation and Prepakt grouting. It was generally employed in the ratio of 2 parts portland cement to 1 of Alfesil. It possesses the property of combining with calcium hydroxide liberated during the process of hydration of the cement and therefore contributes to watertightness and long-continued gain in strength.

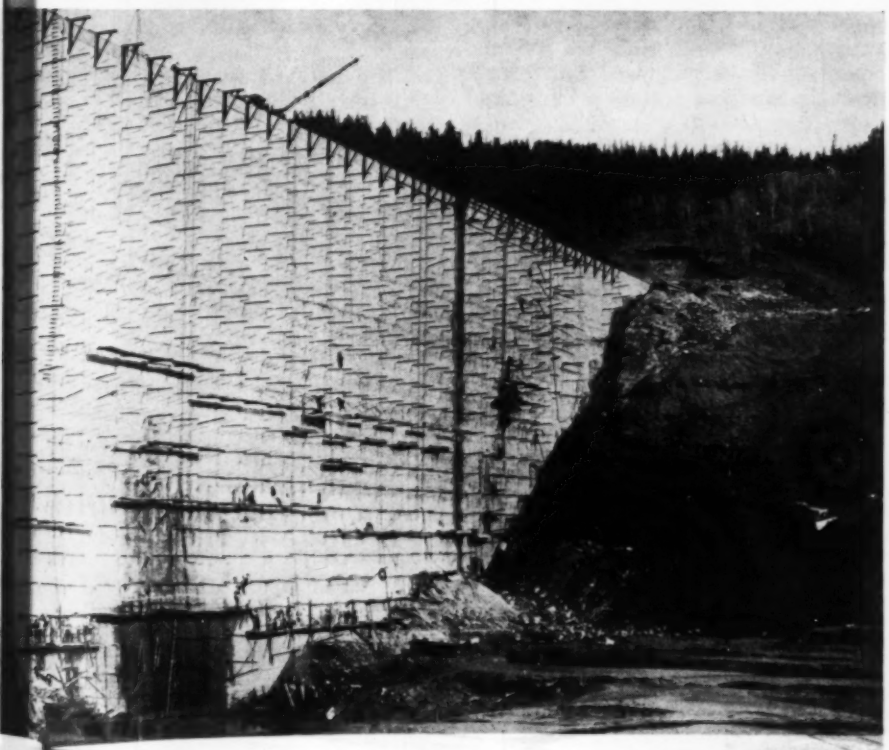
Intrusion Agent was likewise employed in all grout mixes. This is a proprietary compound which prevents early stiffening of grout mixes, reduces the water requirement for a given consistency, prevents agglomeration of cement particles, tends to hold the solids in suspension, and produces a grout which expands slightly before final setting takes place. For sand grouts employed in the intrusion of coarse aggregates to produce Prepakt concrete, Intrusion Agent is usually employed in the amount of about 1 percent of the combined weight of cement and Alfesil.

Foundation Grouting

Preliminary or shallow grouting was done in holes drilled 10 ft deep from the bottom of the foundation excavation at the upstream face of the old dam and were inclined 30 deg with the vertical under the upstream face. While these holes, designated as "B" holes, were usually spaced at 10-ft centers, occasionally they were placed as close as 3 ft.

Because of the badly fractured condition and generally poor quality of the rock immediately below the base of the old dam at the upstream face, additional shallow holes (not contemplated in the original program), designated as "D" holes, were drilled at an angle of 45 deg under the dam, the holes starting from points just above the contact between existing concrete and foundation rock. These holes were drilled to various depths, so that their lower ends would always be below the bottom of the trench excavated along the upstream face and hence above the top of the shallow grout holes which were started in the bottom of this trench.

Many of the 45-deg "D" holes, which were spaced on 4-ft centers, were found to be interconnected by underlying seams; by pumping water into one hole, mud and silt were frequently ejected from adjacent holes and from seams in the rock forming the downstream face of the trench.



WITH RESERVOIR EMPTY, and low-water flow of Boulder Creek passing through drainage tunnel below level of silt and water in foreground of picture, work progresses on chipping and sandblasting face of dam and setting of anchor bars. Scaffolding is held by ledger boards suspended from wire cables. Ledger boards are plainly seen in photo but anchor bars projecting from dam appear as light hairlines.

SKIP DEPOSITS AGGREGATE in forms near base of dam. Usually placement of slabs is kept well in advance of placement of aggregate. Sheet Neoprene (see roll in lower left-hand corner of photo) is cemented over joints on inside of slab opposite contraction joints in old dam. Opposite roll of Neoprene is vertical contraction joint in old dam with porous tile drain cemented in recess at joint. Vertical slotted pipes for grouting and inspection are embedded in aggregate mass.

Usually a group of several holes were grouped at one time after first being flushed until the returning water was clear. Both the "B" and "D" holes were grouted at low pressure with insert packers near the surface, always starting with the lowest hole in the group and working up towards the highest hole, so as to prevent water from being entrapped in the seams.

The purpose of grouting the shallow "B" holes was to close the seams near the surface in preparation for deep grouting at higher pressure. The purpose of grouting the "D" holes was to seal the contact between the existing dam and the underlying rock, which contact had not been well cleaned during the original construction, and to seal the rock seams below this contact surface and above the bottom of the foundation trench. The shallow grout holes of both "B" and "D" series were made by percussion drilling and were 2 in. in diameter.

Following the shallow grouting, deep grouting was done through diamond drill holes $1^3/_8$ in. in diameter, generally ranging from 40 to 60 ft in depth and spaced at intervals of 5 to 10 ft. These deep holes, designated as "A" holes, were inclined 6 deg upstream and generally normal to the rock profile. Stage grouting was done whenever the diamond-drill water ceased to return to the top of the hole and was apparently being lost through the seam. This was the condition for a good many of the holes.

Foundation Grout Mixture

The grout mixture usually employed was composed of two sacks of portland cement, one 100-lb sack of Alfesil, 3 lb of Intrusion Agent, and 20 to 30 gal of water, depending upon the tightness of the formation as indicated by the water test. Sometimes in tight rock formation, to increase the flowability of the grout, the quantity of Alfesil was doubled and the amount of intrusion agent was similarly increased. The grout pressures employed in the deep foundation grouting ranged from 75 psi for relatively open holes grouted in stages near the surface, to 300 psi for tight holes grouted in stages at greater depths.

A reciprocating grout pump of special design was employed for forcing the grout through a single hose line in each hole. Regardless of the length of the supply line, there was no return line; in other words, grout was not circulated to prevent clogging of the supply line as is the customary practice with straight portland-cement grouts. Without benefit of a circulating system, the pumps could be stopped for an hour or longer when any tendency towards plugging of the supply line occurred.

In spite of the relatively low water content of the grout as compared with the straight portland-cement grouts ordinarily employed for fo dation work, the ability of the gro to travel for long distances throu fine seams in the rock was quite r markable. On two occasions, gro flowed through seams beneath t structure, emerging through a sea in a ledge of rock more than 100 downstream from the dam. Tr hairline seams in the schist formati were found to be completely fill when additional rock was remove after grouting of the area.

Approximately 5,000 sacks of c ment and 125 tons of Alfesil we pumped into 4,900 ft of holes. Th effectiveness of the foundation grou ing was demonstrated in the spring 1947, when the flow through seams the abutments and beneath the da was observed to be but an insignifi cant fraction of what it had been previous years.

Foundation Drainage

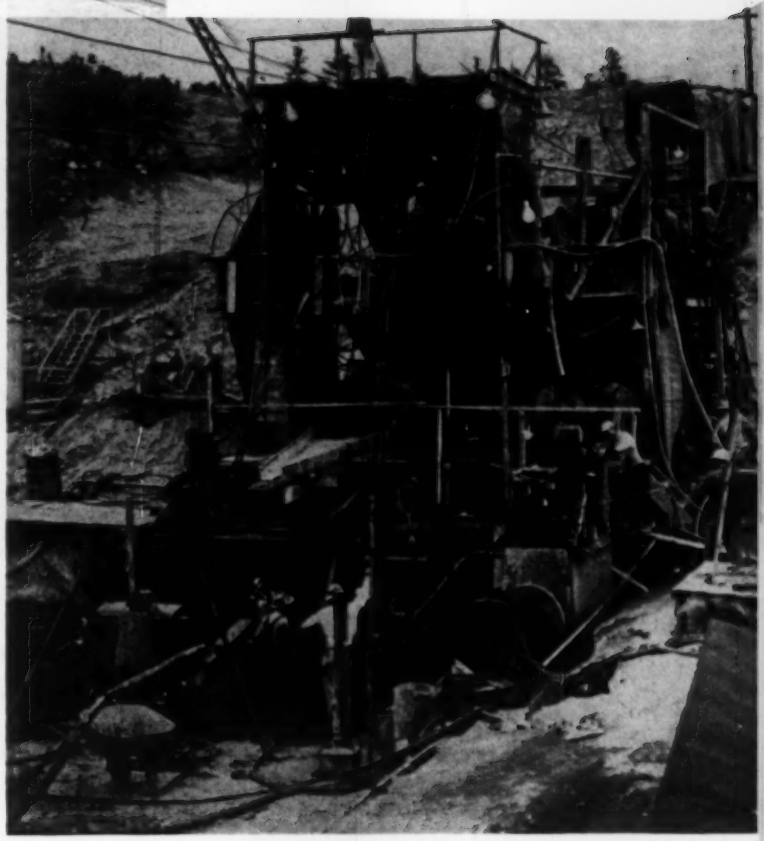
For foundation drainage the "C holes were spaced on 10-ft center and their depths varied from 30 to 4 ft. At the contraction joints in th old dam, which were on about 50-f centers, porous concrete drain-ti were placed in deep recesses with dr pack mortar. The upper ends of th contraction-joint drains were le open, so that at any time in the futur the drains might be flushed out.

The main longitudinal drain which were placed within the con crete of the stepped footings jus above the foundation rock, were o steel pipe in sizes varying from 18 in in diameter along the bottom to 8 in in diameter at the outer ends near th top of the dam.

The upper end of each of the tw branches of the main drain, whic terminate at an elevation 3 ft belo the crest of the spillway, wa equipped with an 8-in. gage valve intended for the occasional flushing of the main drain to remove solid that may accumulate in it. The lowe end of each of the branches of th main longitudinal drain terminate at the transverse drainage tunnel the upper end of which was plugge with Prepakt concrete prior to th construction of the footing for th addition. For control of the water level within the mass of aggregate o the addition prior to grouting and during the grouting operation, a 12 in. valve was installed on the lowe end of each of the two branches of the main longitudinal drain within the tunnel immediately downstream from the tunnel plug.

Stepped Footings

The construction of a stepped footing of conventional concrete upon



BATCHING AND MIXING PLANT on north abutment of dam supplies grout for construction of Prepakt addition to dam. Sand is batched by weight from bin near top of picture. Cement and Alfesil are delivered in bags by gravity conveyor from storage to mixer. Two grout mixers of special design are employed—one as standby unit. Each mixer consists of two horizontal drums with 2-cu yd capacity arranged so that one drum can be charged while operations of mixing and discharging are taking place in other. Discharge material passes down chute to vibrating screen mounted directly over agitator storage tank.

which the precast slabs were to be placed and upon which would rest the Prepakt addition to the upstream face, was performed during the period of October to December and followed closely the operations of foundation grouting and drain installation. Down the sides, where the steps were frequent and at irregular intervals, face forms were of lumber. Across the nearly level bottom, the face forms were principally precast slabs which were left in place.

Along the base of the dam, where precast slabs were used for forms, the joints between slabs which were in line with the contraction joints in the old dam were sealed by strips of Neoprene 8 in. wide and $^1/_{16}$ in. thick, cemented to the inside face of the slab and covering the joint. These Neoprene strips were ultimately carried as unbroken lengths up the inside face of the precast slabs later to be erected; they were designed to act as water-stops since it was considered probable that contraction joints in the old dam would extend themselves in the form of vertical cracks through the monolithic Prepakt concrete blanket forming the addition to the upstream face.

Reasons for Using Prepakt Concrete and Precast Slabs

The reasons for selecting the Prepakt method of construction for the addition to the upstream face deserve explanation. If conventional concrete had been employed, it would have been impossible satisfactorily to complete the work during the period of emptying and refilling of the reservoir, since it would have been economically impracticable to carry on concrete operations during the severe winter months.

Also, it is regarded as impossible to apply a relatively thin blanket of new concrete to a relatively thick mass of old concrete having a substantially lower temperature than the new concrete without the subsequent development of severe cracks as the new and old concrete reach a state of temperature equilibrium. If such cracks develop, obviously the addition cannot act monolithically with the old structure.

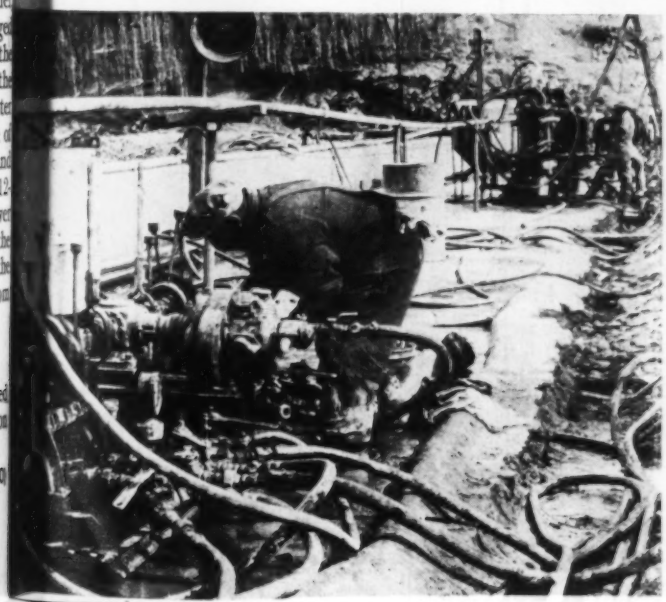
On the other hand, with the Prepakt method the precast slabs for forms and the coarse aggregate fill behind these forms could be readily placed during the winter months, regardless of low temperatures; the aggregate mass behind the slab could be grouted under water when the level of the reservoir was such as to produce the desired horizontal water load on the old dam, thus creating downstream deflection and minimum vertical compressive stresses at and near the upstream face; and grouting could be performed in a mass of aggregate which was of uniformly low temperature nearly equal to that of the cold water in the reservoir.

Results of investigations made by a number of laboratories also disclosed that Prepakt concrete of satisfactory strength and low permeability could be produced with a lower cement content than is commonly found necessary in conventional concrete. A low cement content was considered desirable in order that the temperature rise within the addition due to hydration of cement might be kept to a minimum, thus reducing the tendency toward cracking as the mass cooled.

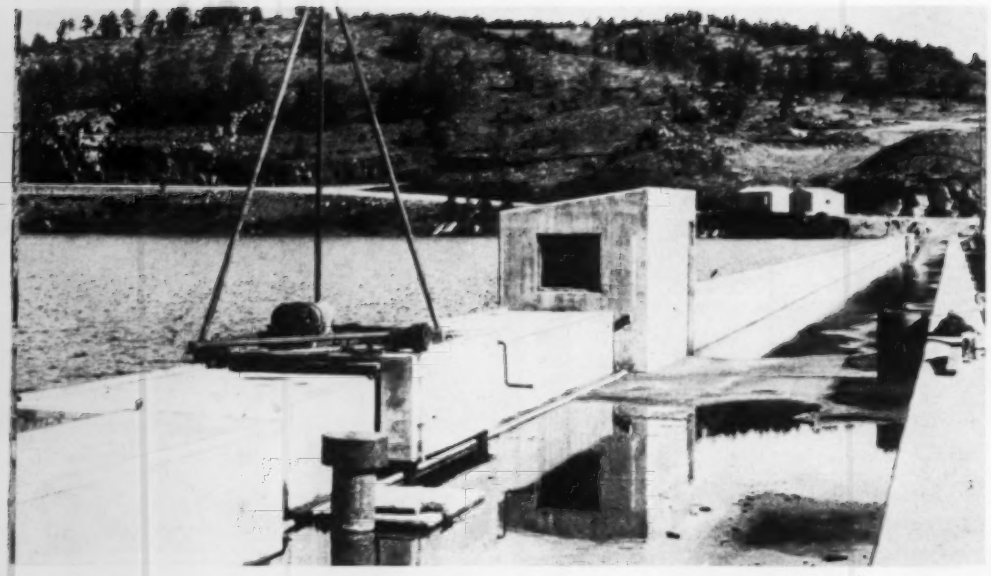
Two other factors which influenced the selection of Prepakt concrete were its relatively low drying shrinkage (about half that of a corresponding conventional concrete) and its superior bond to old concrete (about 50 percent greater than the strength in bond between conventional new and old concrete).

Construction of Precast Slabs

Several factors influenced the decision to employ precast reinforced concrete slabs instead of wooden forms: (1) By employing a high-strength air-entrained concrete for the forms, great resistance to freezing and thawing could be obtained. This was considered to be a matter of importance under the conditions at Barker Dam, where the reservoir is drawn down during the winter months and freezing and thawing of concrete surfaces exposed to sunlight occur daily. With this outer shell of frost-resisting concrete, a low cement con-



SET OF TWO sled-mounted, air-driven triplex distributing pumps meter grout from main supply line through hose inserted in individual grout pipes. Twenty-one such pumps were employed. Mounted on short pipe columns is return line from which grout is discharged into small surge tanks—one for each triplex unit.



WATER IS RAISED to within 3 ft of top of parapet after grouting is completed and drainage system is in operation. Prepakt concrete is brought up to level of roadway on dam. Upstream parapet is of conventional concrete with precast slabs for both upstream and downstream faces. Downstream parapet, of old construction is repaired by chipping and covering with 3-in. minimum thickness of exposed Prepakt concrete. Roadway is new slab of conventional concrete applied after removal of 6 in. of partially disintegrated concrete from top of old structure. Concrete house in center of picture contains equipment for control of hydraulically operated sluice gates.

tent could safely be used for the Prepakt concrete between the old dam and the face slabs. (2) Lumber was scarce and seasoned lumber was unobtainable. To complete the work in the period between the emptying and the refilling of the reservoir, it would have been necessary to place the forms for substantially the entire upstream face a considerable time before grouting. Under these conditions, shrinkage and warpage of the forms would probably have caused openings of sufficient size to permit the escape of grout into the reservoir during the grouting operation. (3) Finally, it was estimated that timber forms of sufficient strength to safely carry the horizontal thrust produced by coarse aggregate placed to the full height of the dam would be more expensive than precast slabs.

Preparation of Upstream Face

The operations of chipping and sandblasting the upstream face and setting the anchor bars followed the receding water level in the reservoir. These operations were performed from hanging scaffolds which permitted work on any part of the face merely by shifting planks from one set of ledger boards to another.

More than 6,000 anchor-bar holes, 2 in. in diameter, were drilled in the upstream face of the dam to a depth of 3 ft. The holes were drilled on a downward incline of 10 deg, so that they could be completely filled with grout before the anchor bars were placed.

After drilling, the holes were cleaned with an air-water jet, and grout was injected from back to front, using a 1-in. hose which was gradually withdrawn as the hole was filled. Thereafter the anchor bars were inserted and gently tapped to insure their complete contact with the fresh grout. The grout was composed of one part portland cement to two parts fine sand, with sufficient aluminum powder added to produce about 5 percent expansion during the early setting period.

Proof testing of anchor bars was accomplished by applying a tensile load of 25,000 lb to each bar through a jack arrangement. No slippage was observed on any of the bars thus tested.

Erection of Precast Slabs

The precast slabs, generally $6^1/_2 \times 12$ ft by 8 in. thick, which served as forms for the addition to the upstream face, were placed during the winter and spring months, when for much of the time the weather was bitterly cold and winds of high velocity blew down the canyon. In spite of the generally bad working conditions, 1,009 face slabs with a total weight of 4,025 tons were set without a single accident. The daily rate of slab placement during an 8-hour shift increased with the experience of the crew and improvement in weather conditions. The maximum number of slabs placed in any one 8-hour day was 27, and the average number placed daily during the month of April was 15.

As the slabs arrived at the dam from the storage yard, they were lifted directly from the truck and swung into position on the face of the dam. Each slab was set on and against a metal spacer shim calculated to maintain the required elevation and stationing and to provide joint openings of suitable width for later grouting. Final positioning was usually accomplished within 4 minutes by two men working with crowbars while the crane maintained tension on the load line.

Anchor-bar welds selected at random were proof-tested by applying a tensile load of 25,000 lb.

After each course of slabs was erected, joint openings between slabs, which were generally about $^1/_8$ in. wide, were filled with an air-entrained grout composed of two parts cement to one part Alfesil. The grout was retained on the upstream face of the slab joints by 3-in.-wide muslin strips cemented to the concrete with Duco cement, and on the downstream face by a stiff mortar worked into the joints some time before the grouting operation was started.

The coarse aggregate for the Prepakt addition was placed by means of 4 cu yd skip and truck crane.

Generally the erection of slabs was kept considerably in advance of the placement of aggregate, so that it was necessary to drop the aggregate for some distance into the forms. To prevent segregation and breakage, planks were placed across the anchor bars so as to form a rock ladder. In this manner, excellent distribution of particle sizes was achieved. As the course aggregate was built up in the forms, strain-meter observations were made from which stresses in the anchor bars and form pressures were calculated.

Grouting of Prepakt Addition

To maintain the desired water level in a mass of ungrouted Prepakt aggregate behind the face slabs as the water in the reservoir rose it was necessary to prevent flow of water through the drainage system. Under these conditions, the foundation drains were of course totally ineffective in preventing the development of uplift pressures, and up until the time of grouting the assemblage of slabs and the mass of aggregate behind them would have an unknown and possibly negligible effect in so far as the stability of the structure was concerned.

Because of these conditions, it was considered necessary to start the grouting operation prior to the complete filling of the reservoir, and a water elevation 10 ft below the crest of the spillway was fixed as the maximum permissible before grouting was

begun. It was desired that the water level be nearly at this elevation at the start of the grouting operation so that the dam would be deflected downstream and that the vertical compressive stresses at the upstream face would be small. It was calculated that, with drains closed, the water level in the reservoir might be permitted with safety to reach the crest of the spillway at the time of completion of grouting.

Because of the uncertainty of a continued runoff sufficient to completely fill the reservoir and because of the great value of the water held in storage, it was required that no water be wasted until the reservoir was filled. Grouting, which was started when the water in the reservoir was 15 ft below the crest of the spillway, proceeded continuously except for short interruptions until the entire mass of the addition from the bottom to the top of the dam had been grouted—in a period of only 10 days. The water level in the reservoir reached the crest of the spillway one hour before grouting was completed. During the 10-day grouting period more than 4,000 cu yd of grout was intruded into the coarse aggregate of the addition, thus producing 13,000 cu yd of Prepakt concrete.

Grouting Plant

The grouting plant was quite unique. It consisted of a batching and mixing plant erected on the north abutment, a main pumping plant at the north end of the dam, a main supply line running along the crest of the dam for its full length with a return line back to the main pumping plant, and a series of small distributing pumps mounted along the roadway to which were connected hoses that were inserted in the 2-in. vertical slotted grout pipes previously placed in the coarse aggregate of the addition.

From the mixer the grout was discharged into an agitator storage tank, whence it was pumped by the main pump through the 3-in. supply pipe to the south end of the dam and back through a return pipe which decreased in size in steps from 3-in. to $1^1/_4$-in. diameter. At intervals along the return line were located valves for filling small surge tanks, each connected to the intake of one of the small distributing pump stations along the roadway. The return line brought back to the storage agitator tank all grout not taken by the small pumps.

The distributing pumps were small triplex units with a single discharge from each cylinder. As the pumping operation was started, hose from these connections were inserted to the full depth of alternate grout pipes on 8-ft centers and were gradually withdrawn—always keeping the lower end below the grout level as the work progressed.

The vertical pipes into which no hose was inserted, termed "inspection pipes," were employed to determine the grout level at frequent intervals. The rate of pumping at any location was controlled in this way. The inspection pipes were also employed for determining the temperature of the grout at and near its surface, the level of the water within the mass of ungrouted aggregate, and the temperature of the water immediately above the grout level.

Grout materials were proportioned as follows: 2 sacks of cement, 100 lb of Alfesil, 3 lb of Intrusion Agent, 300 lb of sand, and about 16 gal of water. In order that the initial temperature of the grout might be low, the water supply was obtained by pumping from the reservoir with the intake of the pump at a level where the temperature was about 43 deg F. The average temperature of the grout as it left the mixer was about 57 deg F.

Form Pressures

The stresses in 44 anchor bars to which Carlson strain meters were attached were calculated, and the pressures against the slab form, during the process of filling with aggregate and the later process of grouting, were determined. In general, the lateral forces produced by the aggregate were considerably greater than those which might be expected from a granular material placed without vibration, and the variations in pressure, as indicated by different meters, were large. Not infrequently the maximum lateral force was produced when there was only a few feet of aggregate above the meter. In such cases the pressure usually decreased with further additions of aggregate.

(*Continued on page 84*)

Radio-Telephone Enters Heavy Construction Field

OFFICE-TO-TRUCK COMMUNICATION (left) by two-way FM radio-telephone with 25-mile range saves time and money for excavator and grading company whose work requires quick assignment and equipment transfer, often involving changed instructions en route. As job is finished, tractor-trailer (right) of George J. Igel & Co., Inc., Columbus, Ohio, is ordered by radio-telephone to move backhoe to next site. Procedure permits company to get most efficient use out of its 17 pieces of excavating equipment. Receiver installed below instrument panel has selector to divert calls to particular vehicle, with signal often attached to horn in case driver is out of cab. Radio-telephones are also being used for auto-repair work in quick response to breakdown calls on congested arteries or long bridges, thus reducing delays and traffic snarls.

HEAVIER WHEEL LOADS emphasize importance of structural design for rigid pavements. Graders and sheepsfoot rollers prepare fill for extension of runways at Patterson Field, Dayton, Ohio. Project involves handling approximately 859,000 cu yd of excavation and borrow in constructing runway for B36 aircraft, world's largest land-based bombers.

Full-Scale Research Advances

Design of Rigid Pavements For Heavy Wheel Loads

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Head Engineer, Ohio River Division Laboratories, Cincinnati, Ohio

PROGRESS IS REPORTED herein on the investigations of rigid pavements conducted by the Corps of Engineers, Department of the Army, from October 1941 to the present time. In that period nine accelerated traffic tests on full-scale installations have been conducted, three on existing pavements, and six on prepared test sections. Wheel or wheel-group loads ranging from 20,000 to 150,000 lb have been used on appropriate pavements 5 to 24 in. thick. These studies include considerations of checking existing theories under idealized conditions, design requirements for single-wheel traffic loading, the effect of multiple-wheel-group loadings, overlaid or "beefed-up" pavements, base course, joint transfer, slab size, reinforcement, thermal and seasonal stresses and creep. This article is based on a paper presented before the Soil Mechanics and Foundations Division at the ASCE Annual Meeting.

IN THE LATE THIRTIES, most highway and airport pavements were designed and selected without much regard to structural analysis. Experience indicated this procedure to be correct because wheel loads had not exceeded 15,000 lb and the minimum thickness required for construction and durability satisfied structural design requirements. Many observations, attempted correlations and conclusions, drawn prior to this time, are clouded by this condition. The development and use of heavier aircraft loadings now demand structural analysis. Nonetheless, there are still those who believe that a nominal thickness of well constructed concrete pavement is sufficient for any applied load.

IN ADDITION to these full-scale studies, simultaneous investigations on the effect of impact, traffic distribution, vibrations, rocket and jet blast have been completed, together with airport pavement performance observations through periodic condition surveys of existing airfields, and the detailed examination of all reported failures. Supplementary information is being gleaned by detailed examinations of the physical properties of materials and the use of models. All this information serves to improve the design of rigid pavements and the alighting gear of aircraft, thus bettering the performance of airfields.

A statement made by a superintendent of airports for the Civil Aeronautics Administration at the Phoenix meeting of the ASCE provides an excellent example of this attitude: "This mumbo-jumbo of the past few years about high wheel loadings, repetition of load, optimum moisture, liquid limit, plasticity index and compaction every time we want to build a simple...facility is all right up to a certain point...." Although it is not the writer's purpose to take issue with this statement, it serves as a reminder that the need for structural design had better be demonstrated.

Two of many available examples are probably sufficient for this demonstration—a destructive, full-scale traffic test and a well-evaluated performance record. Figure 1 illustrates the disastrous result of subjecting a 6- and 8-in. concrete slab pavement at Lockbourne No. 1 Air Base near Columbus, Ohio, to traffic of a 37,000-lb wheel load.

Table I summarizes the results of crack surveys of three runways at the Vandalia, Ohio, airport, an outstanding example of pavement reaction and destruction under increasing wheel loads. Unfortunately this example is far too typical of what is happening to many of our airfields today.

Even these two selected examples

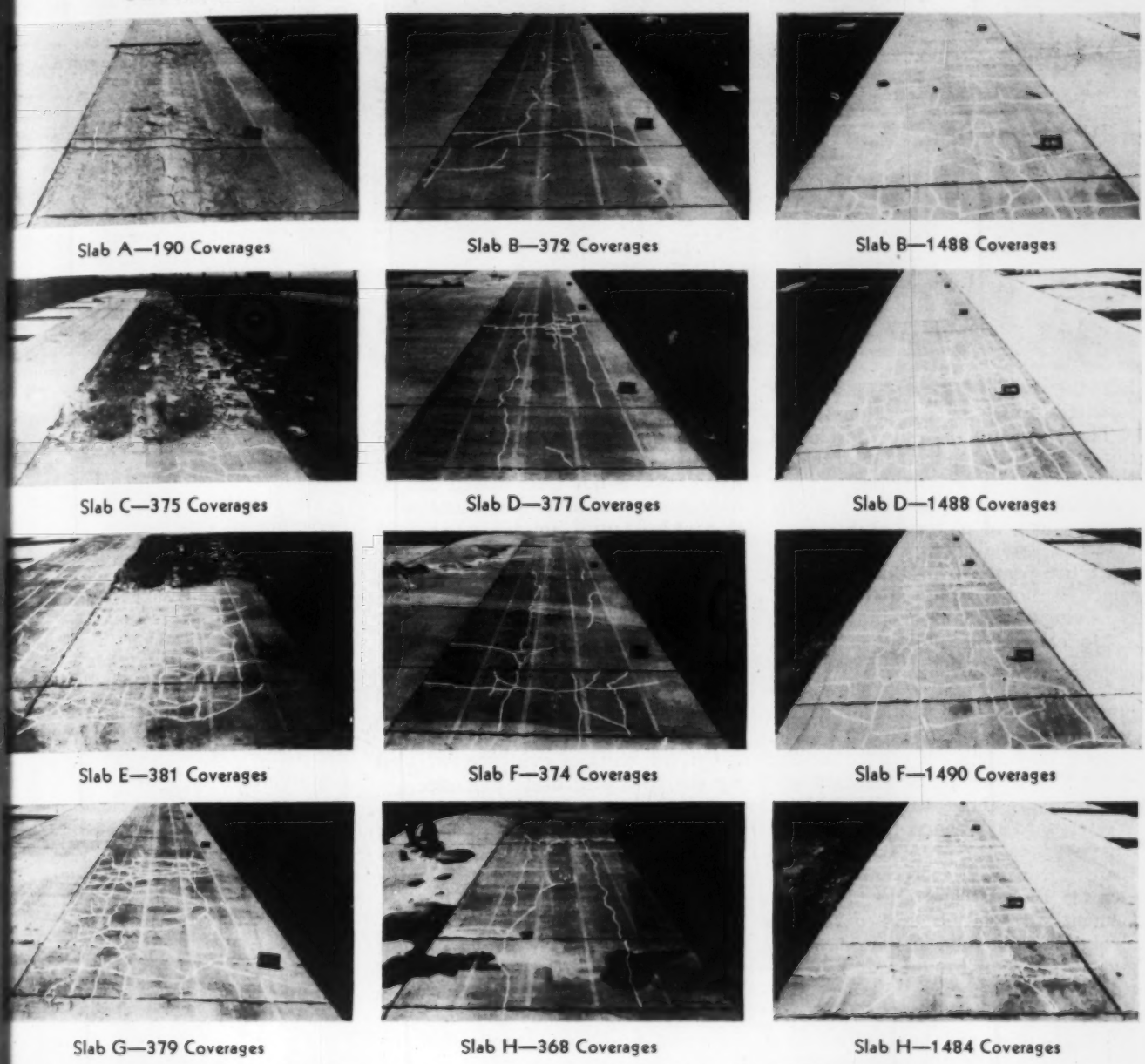

FIG. 1. SERVICE BEHAVIOR of 6- and 8-in. plain concrete slabs under 37,000-lb wheel load traffic is studied at Lockbourne No. 1 Air Base near Columbus, Ohio, to determine efficacy of base course. Tests show that when base course is used on less rigid subgrade, and rigid pavement is overloaded to cause serious failure, later traffic causes more rapid destruction than same pavement without base course.

indicate the absolute need of structural analysis to fix the design of heavy-duty pavements. Lest anyone should be lulled into believing that it always takes time for failures to develop, Fig. 2 is included to show the break-through that occurred after parking a 150,000-lb wheel load on a 9-in. concrete pavement for only a few minutes.

Verification of Theory

In 1941, the only theory available for application to such a problem was that developed by H. M. Westergaard, M. ASCE, later published in the April 1942 PROCEEDINGS of ASCE. The Portland Cement Association originally published this theory modified by Westergaard to conform to the results of the Arlington load tests for use in the design of highways. It was found, however, that the correction so determined resulted in a disproportionate reduction in requirements when applied to heavy aircraft wheel loads.

This analysis applies only to center loading, in contrast to edge and corner loading, and references to it herein are to the form given in the April 1942 PROCEEDINGS paper. In the May 1947 PROCEEDINGS of ASCE, Westergaard published new formulas for stresses in concrete pavements based on an analysis of the edge condition, and in this form it is used for comparisons.

Since 1941 a series of static loading tests on full-scale concrete slabs have been conducted on thicknesses varying from 6 to 24 in. These tests started in October 1941 at Wright Field, Ohio, and continued there through 1942; they started again in the summer of 1944 at the Lockbourne Army Air Base near Columbus, Ohio, and are still continuing there. The conditions surrounding these tests simulate, as closely as practicable, the conditions assumed by the theory,

FAILURE OF 5-IN. CONCRETE apron
Godman Field, Fort Knox, Ky.—caused
limited traffic of 26,000-lb wheel load—
sults in disintegrated pavement and
placed subgrade. Note upheaval of slab
left edge of failure.

but the practical limitations bring forth the following exceptions:

The slabs are of finite horizontal dimensions; the concrete used in the slabs is not necessarily elastic; the subgrade soil is not necessarily stress-strain linear in a vertical direction; and the loaded area simulates aircraft tire prints. In addition, time, which is not a factor in the theory, is proving to be an important variable.

Models embodying the same conditions are also under study, and since both model and field tests show similar tendencies, a few model results are summarized in Fig. 3. The general magnitude of center loading stresses is shown to be substantially the same as those calculated from Westergaard's Theory, whereas the edge stresses are proportionally less than theoretical. Recently Prof. Gerald Pickett and the Portland Cement Association has developed a solution for a solid subgrade, which gives promise of ironing out some of these discrepancies.

The above-mentioned studies of full-scale and model slab loadings also indicate that the thickness requirements of edges and corners of slabs control the design of slabs. This fact is well verified by traffic tests and experience. The rational design of pavements will be in question just so long as theory and measurement are in conflict. However Fig. 3 does show similarity in stress distribution even though the absolute value of each is in question. The value of this similarity is now being stretched to its limit when it is used as an excuse for interpolation and extrapolation of traffic test results. For the moment it remains the weakest link in the analysis.

A discussion of the effect of traffic on the validity of application of any theoretical analysis can well begin with the statement of a hypothesis. If the initial theoretical boundaries are allowed to deteriorate progressively in any fashion or degree with repeated loadings due to traffic, then the pavement must fail. If this hypothesis is not true, design can be only a matter of empirical correlation, at least until our ability to reason is vastly expanded. On the other hand if this hypothesis is true, a working theoretical analysis is within reason. The acceptance of this hypothesis does more than that, however, for it implies two criteria of design; one based on safe working stresses of concrete, the other on a limit of strain repetition of soil.

On the basis of evidence revealed by the tests and other evidence observed it is concluded that the hypothesis, as stated, is correct. The significance of its acceptance is twofold: it enhances orderly thinking as to causes of failure, and it requires the establishment of an additional criteria, based on strain-limit properties of soil, for design of rigid pavements. Such criteria have been developed, but are now the subject of intensive study for future report.

Tentative Design Requirements

Even though these criteria are not set, the acceptance of this hypothesis has influenced our thinking in setting tentative standards for pavement design. It must be stated further that this general program of investigations and observations, extensive as it is, yields very few pin-pointed results. The maximum obtainable from the nine full-scale traffic tests conducted is seven points with which to help fix a family of design requirement curves. Observations of pavement performance yield very little general design information in less than ten years. Even that information tends to fall into three groups—pavements grossly overloaded which break up rapidly, pavements properly designed for wheel loads in use, and pavements designed for wheel loads greater than those
use.

Of the 600 or more airfields
served by the Corps of Engineers
the United States, at least 350 ha
some concrete pavement. Of thes
only six now fall in the second gro
and one only has reacted und
traffic sufficiently to yield positi
information. Strangely enough th
airfield is the Lockbourne Army A
Base, where so many of our investig
tions have been concentrated. Nee
less to say, all these observation
have added much in the way of d
tailed knowledge of pavement pe
formance.

The results of both traffic tests a
performance observation have be
used to adjust theoretical design r
quirements. These are shown in Fi
4 in the form in which they appear
the Engineering Manual for Depar
ment of the Army Construction, Pa
XII, Chapter 3, May 1946. The r
quirements are being rescrutinized
the light of newly developed informa
tion, and adjustments will be made
necessary. How then are these bas
requirements to be modified by su
factors as base course, joint transfe
reinforcement, temperature stresse
overlay design and multiple-whe
gear? This question will be answere
by a summary discussion of the effe
of each of these factors as observed

Base Courses

This discussion of the structur
effects of the base course exclud

FIG. 2. BREAK IN 9-IN.-THICK CO
CRETE pavement is caused by 150,00
wheel load of test rig. Break-through
curring in matter of minutes indicates t
such failures do not always require
amount of time to develop.

TABLE I. PERFORMANCE RECORD OF DAYTON MUNICIPAL AIRPORT

NE-SW, E-W, and NW-SE Runways

Date of Survey	Number of Pavement Breaks: Diagonal	Corner	Shatter	Total	Max. Gross Operating Load
Aug. 1942	0	22	0	22	18,000 to 26,000
Oct. 1943	6	38	11	55	25,000 to 37,000
July 1945	471	624	205	1,300	58,000 to 76,000*

* Loading started spring of 1944.

Note: In service since December 1936. Design 7-5-7. No base.

requirements for frost control, pumping preventatives and construction expedients such as building a work platform in adverse weather. The value of a base course in highway design has been in dispute for many years, and a great deal of conflicting evidence has been used in support of either its inclusion or omission. The advent of heavier wheel loads, having brought with it prime requirements of structural design instead of durability of construction, also helps to clarify the base-course problem. It was thought, as the result of the first static loading tests, that granular base courses gave great structural benefits.

For example, the early Wright Field tests showed that an 18-in. gravel base course doubled to tripled the ultimate bearing capacity of 6-, 8- and 10-in. concrete pavements in center loading. This optimism was short lived, however, for subsequent traffic and repeated static loading tests showed these structural benefits to be very small and generally uneconomical. What is more, traffic tests revealed a more significant danger, which once revealed becomes axiomatic. Without exception, when a base course has been used on a less rigid subgrade in supporting a rigid pavement, and that pavement has been overloaded so as to cause serious initial failure, subsequent traffic on that pavement causes much more rapid destruction than it would on the same pavement without a base course. In support of this evidence, reference is made to Fig. 1 and the view designated "Slab E." In the foreground appears a 6-in. concrete slab placed directly on a lean clay subgrade cracked but passable after 381 coverages. In the background are 6-in. slabs on 6-in. base courses impassable even though patched after 75 coverages. These are shown to better advantage in the view designated "Slab C."

The same tendency was observed at Lockbourne No. 2, where 15-in. slabs reacted better under a 150,000-lb wheel loading than did the same slabs on a 15-in. base. This effect has also been observed on numerous airfields in operation. In addition, repetitious static loading tests on slabs with a base course produced erratic results.

In the light of the above facts and particularly considering the uncertainty as to future aircraft wheel loads it is concluded that the use of a base course should be discouraged for airfield pavement. If a base course is necessary because of frost, pumping or construction, other than cohesionless types are suggested.

Reinforcement Proved Uneconomical

Reinforcement produces distinct structural benefits, but within the scope of the writer's observations its use has proved uneconomical. Results with 37,000-lb wheel loads indicate that the use of 91-lb mesh in an 8-in. slab, top only, provides greater lasting qualities than does 12 in. of base course under the same slab. Use of 159-lb mesh in 8-in. slab produces even better results, but not as good as a plain 10-in. slab. From the viewpoint of cost, the latter is usually the cheaper. These and subsequent tests on Lockbourne No. 2 indicate a general increase in structural benefits with an increased quantity of steel. However, the increased benefits do not keep abreast of the increase in cost, with the result that the favorable effect of using increased steel rapidly vanishes.

Many designers, the writer among them, look with favor on the lasting qualities a nominal amount of steel will supply and usually provide for its inclusion in design to retard the spread of accidental cracks. This procedure is doubly sound in view of the unsettled state of future aircraft loads. If these loadings do increase in the future, and they probably will, the use of truss-like concrete slabs with structural steel top and bottom, well separated, offers attractive possibilities for a solution. Even now, this type of construction is being investigated.

Joints and Joint Transfer Devices

There is no subject related to rigid-pavement design more controversial than that of joints and joint transfer devices. Therefore this subject received major attention in our investigational program. Eighteen types of joints were included in Lockbourne No. 2, 17 for test. Eleven types were included in Lockbourne No. 1. In addition, exhaustive field performance, theoretical and model studies have been conducted.

Between joint types an ascending order of acceptability is discernible as follows: keyed construction, free, expansion, doweled construction and dummy groove. Free joints should never be used; keyed construction joints are very objectionable, expansion joints should be avoided if possible; the remainder are better. Although detectable differences were

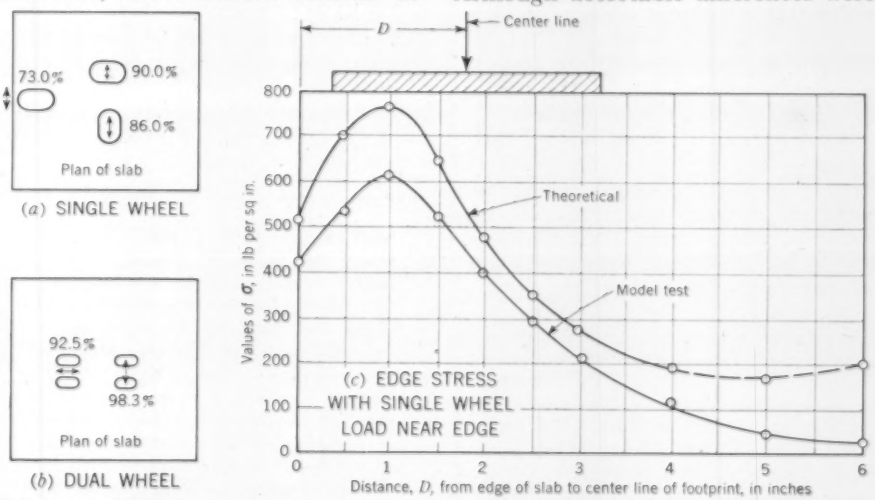

FIG. 3. AGREEMENT BETWEEN THEORY and actual measurement has been good for center loading, but theory indicates consistently higher stresses for edge loading than those measured. Deformations are also found in reasonable agreement for center loads, but theory indicates greater edge deformations than measured. Numerals in parts (*a*) and (*b*) indicate percentage of experimental stress to theoretical stress. Arrows indicate direction of stress. Diagram (*c*) gives comparison of model test stresses with Westergaard theoretical stresses.

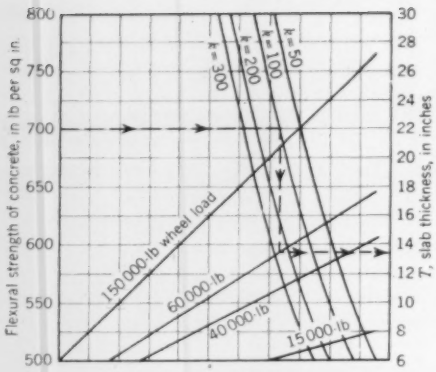

FIG. 4. PAVEMENT DESIGN CURVES for runways, as they appear in Engineering Manual for Department of the Army, are being studied in light of new information. Slab thickness of T = 13.3 in. is found for concrete with flexural strength of 700 psi, subgrade modulus k = 100, and wheel load = 60,000 lb, by following dotted line.

measured for the different types of joint-transfer devices tested, there was no effective difference in the over-all results.

If conclusions are to be drawn from limited results, it can be stated in general that the performance of a pavement is unaffected by the design of transfer devices except for keyed joints, which are generally unsatisfactory. Also, an adequate pavement is not appreciably weakened by weaker devices, and an inadequate pavement is not strengthened by stronger devices. This statement appears to be incongruous, particularly if it is judged in view of existing theories. These theories, however, are predicated on the control of stress within the concrete, whereas there is an ever-mounting suspicion that the function of transfer devices is to control deformations within the strain repetition limit of the subgrade.

Since Mr. E. P. Bone has recently presented an analysis of temperature stresses in heavy concrete pavements based on temperature measurements made at Lockbourne and Fairfield-Suisun in California, only a few salient points are here offered:

1. Based on long and continuous temperature recordings at different elevations in the slab and in the subgrade, the assumption of linear temperature gradients in slabs greater than about 8 in. thick is not valid.

2. Based on joint-opening measurements over a period of two years, the joints of thick pavements without expansion joints remained closed in the hotter part of the year (in Ohio, June to October), at which time the slabs were in horizontal compression.

3. In such a slab system this horizontal compression balances or overcomes the tensile stresses due to daily variations during the summer season. This is indicated by comparative deformation measurements.

4. The critical temperature stresses occur in the cooler part of the year, probably in the spring or fall.

5. Calculations based on temperature measurements in thick slabs and the thermal coefficient of expansion of concrete indicate that these stresses are less than 100 psi.

It is suggested therefore that when non-expansive aggregates are used in concrete, expansion joints be omitted in thicker slabs.

Overlay Performance

The problem of structurally improving or "beefing up" an inadequate pavement has received considerable attention both in performance observation tests and in analyses. The existing concrete slab was reinforced by placing another rigid slab immediately on top of it at Fort Wayne, Ind., at Bowman Field, Ky., and at Lockbourne No. 1 and No. 2. Although this type of treatment gave satisfactory performance, its application has been discarded in favor of non-rigid types of overlay. It has been found, by full-scale tests at McDill Field, Fla., Maxwell Field, Ala., and Lockbourne No. 3, Ohio, that treatments of as little as 3 in. of asphaltic concrete give astounding structural benefits.

These unexpected benefits were also indicated by the Hamilton Field, California, test, where a three-layered system—rigid slabs, 9 to 15 in. thick on top and 6 in. on the bottom, separated by 5 to 22 in. of less rigid material such as crushed stone or asphaltic concrete—produced very good over-all results. Accelerated traffic tests have shown overlays of less rigid material to be so beneficial that original designs utilizing a rigid slab of moderate thickness covered with a flexible-type surface can and probably will be in cost competition where conditions are favorable.

MUCH OF THE CONTROVERSY about the design of pavements is in reality a discussion of the question, "For what considerations should pavements be designed?" Until recent years the design of rigid pavements for highways was controlled by considerations of durability of concrete and construction requirements. Increased wheel loads have shifted the design control to structural considerations, particularly for airfield pavements. What then are the future loads for which present-day pavements should be designed? The most logical agencies for prognostication, the aircraft designer, manufacturer and operator, indicate that we are but entering an era of bigger and better aircraft.

In an attempt to reduce the pavement requirements for heavier aircraft, pavement designers are exerting all possible pressure on aircraft designers to use multiple-wheel gear. This is done on the assumption that dividing the load into more points of application will be beneficial. The success of these efforts is indicated by the changing of the main gear of the B-36, so that the nominal 150,000-lb load transmitted by one 110-in.-dia. tire is now applied by four 56 × 16-in. tires in twin-tandem arrangements spaced $31\frac{1}{4}$ in. on centers laterally and $61\frac{3}{4}$ in. on centers longitudinally.

The effect of this change has been estimated by calculations, full-scale strain measurements and model study to be a 50 percent reduction in critical stress. However, there is still considerable question as to the advisability of depending upon critical stress control, when limiting strain-repetition of the subgrade at edges and corners may control. Full-scale traffic tests of these conditions are now under way at the Lockbourne Army Air Base, Ohio.

Acknowledgments

These studies were conducted with the authority of and by the direction of the Chief of Engineers, Corps of Engineers, Department of the Army. The information presented herein is approved by him, but the views and opinions expressed are those of the author and do not necessarily express the policy of the Department. The gathering of pertinent information is a Corps-wide study which has utilized the services of several hundred individuals.

Several of these men deserve particular mention: Messrs. Gayle McFadden and Thomas B. Pringle, Members ASCE, for over-all direction; Prof. Raymond E. Davis, M. ASCE, University of California, who directed the Hamilton Field studies; Mr. Fred A. Robeson, the Maxwell Field studies; Mr. K. F. Gunn, the McDill Field studies; Messrs. M. K. Johnson (deceased) and Robert F. Jackson, the Fort Knox studies; Mr. Edgar Alcott, the Northern Field studies. This work centered in the Ohio River Division Laboratories, designated as the Corps' Rigid Pavement Laboratory, where Messrs. F. M. Mellinger, Assoc. M. ASCE, E. P. Bone, and C. H. Christiansen acted in supervisory capacities. Dr. H. M. Westergaard, M. ASCE, Dr. P. C. Rutledge, Assoc. M. ASCE, Mr. O. J. Porter, M. ASCE, Mr. J. L. Land, M. ASCE, Dr. F. C. Lang (deceased) and Dr. Francis Baron acted as consultants.

Court Denies Recovery of Increased Dredging Costs Caused by Hurricane

Decides Against Contractor in Case Based on Changed Conditions

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ACCORDING TO THE majority decision of the Court of Claims, changes in the amount and character of dredging caused by a hurricane do not entitle a contractor to additional compensation. An interesting litigation between a dredging contractor and the Government, the ruling of the court based on its interpretation of the specifications of contract, and a dissenting opinion filed by one of the three judges on the case are presented in the following account. The case is that of the Arundel Corp. versus the United States, reported in 103 C. Cls. 688. The article also quotes from other decisions of the Court of Claims in regard to responsibility for subsurface conditions not disclosed by the information furnished bidders, and cites an example of protection for contractors in such cases.

SPECIFICATIONS for dredging a section of the Cape Cod Canal stated that the site was not exposed to storm action, gave the maximum current velocities and tidal ranges, and further stated that, "Failure to acquaint himself with all available information concerning these conditions will not relieve the contractor of responsibility for estimating the difficulties and costs of successfully performing and completing the work as required." After describing the materials found in dredging an adjacent area, the specifications set forth that the Government "does not guarantee that other materials will not be found nor that the proportions of the several materials will not vary from those indicated by the explorations."

Application of Article 4

The specifications further stated that "if materials, structures or obstacles of a substantially different character are encountered in the execution of the prescribed work and the cost of their removal or satisfactory treatment obviously would be, in the opinion of the contracting officer, either in excess of or less than the contract price, the contracting officer, in either alternative, will then proceed in accordance with the provisions of Article 4 of the contract."

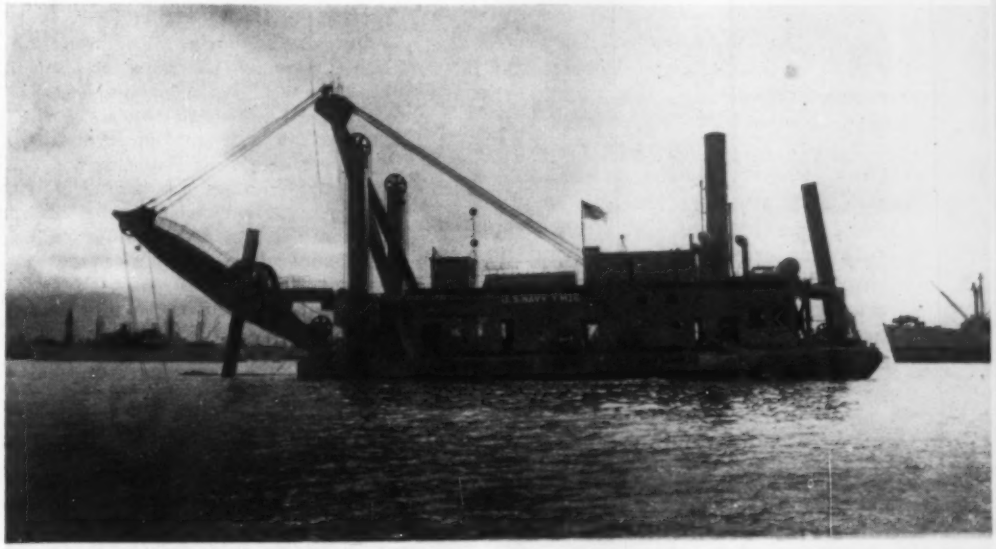
Article 4 of the contract (Standard Government Contract Form) reads:

"*Changed Conditions.* Should the contractor encounter, or the Government discover, during the progress of the work subsurface and/or latent conditions at the site materially differing from those shown on the drawings or indicated in the specifications, or unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the plans and specifications, the attention of the contracting officer shall be called immediately to such conditions before they are disturbed. The contracting officer shall thereupon promptly investigate the conditions, and if he finds that they do so materially differ the contract shall, with the written approval of the head of the department or his duly authorized representative, be modified to provide for any increase or decrease of cost and/or difference in time resulting from such conditions."

Erosion Reduces Dredging Quantities

Experience with similar work in the vicinity had shown that, owing to rapid currents, material in the dredged cuts was eroded when disturbed by the process of dredging. For this reason the quantity of material to be removed was estimated to be 75 percent of the actual amount in place.

Bids were opened on August 24, 1938. After some negotiations a unit price was agreed upon on September 10, 1938, and the contract was executed on October 6. Meanwhile, on September 21, 1938, a destructive hurricane swept the New England coast. During this hurricane the velocity of the wind was so great as to cause a current of from 10 to 12 miles an hour in the canal, removing a considerable amount of material from the area covered by this contract. Principally, if not entirely, from this cause the contract was re-



CONTRACT DISCUSSED in text stipulates calling attention of contracting officer to conditions at site differing from those indicated in specifications. U.S. Navy steam dipper dredge *Hellgate* pictured here has steel hull, 140×48×15 ft deep; and draft of 12 ft forward and 9 ft aft. Steam-driven dredge has 8-cu yd dipper and can dredge to depth of 50 ft with maximum capacity of 7,500 cu yd in 24 hours.

COURT DECIDES CONTRACTOR is not entitled to extra compensation for loss of material eroded by swift current resulting from high-velocity wind in area covered by contract. In view above, clamshell dredge *C. F. Weeber* owned by Hawaiian Dredging Co. is shown clearing shipping channel in waters near Hawaii. Dredge has hull 110×45×9.2 ft deep and displaces 458 gross tons. Its power plant is diesel-electric, rated at 240 hp, and its clamshell bucket has capacity of 4 cu yd.

duced by 425,950 cu yd from the original estimated amount of 2,894,500 cu yd. The fact that there had been a material reduction in the amount of excavation was not known when the contract was executed but was discovered prior to the commencement of dredging operations. The contractor at once requested either an increase in the unit price or the addition to the contract of a compensating amount of work.

This request was denied and the contractor entered suit, claiming that the material removed by the hurricane was the more easily dredgeable material with a high bank, that the average haul to the dumping ground was increased and that the reduction in quantity increased the unit cost of fixed items such as moving plant to and from the job. Further it was claimed that an increase in price was justified because of a "changed condition" under Article 4 of the contract, as quoted above.

Majority Opinion of Court

The Court of Claims stated in its (majority) opinion: "It will be seen from the specification provisions referred to that defendant only gave plaintiff the information which it had obtained in June, 1938, and made no warranty or binding representation that plaintiff would not encounter conditions different from those indicated. . . . it only bound itself to make an equitable adjustment if materials, structures or obstacles of a substantially different *character* from those described . . . were encountered, and that did not occur."

"The subsurface or latent conditions materially differing from those shown or indicated in the contract, referred to and contemplated in the first part of art. 4, were subsurface or hidden conditions which actually existed but were unknown by either party at the time the specifications and drawings were prepared and at the time the bid was submitted and accepted, and because of which unknown conditions the representation or indication in the plans and specifications would have to be substantially varied or changed in order for the defendant to obtain the completed work as called for and intended by the contract."

"We think the Government did not, by art. 4, assume an obligation to compensate plaintiff through an increase in the contract unit price for any increase in its anticipated dredging costs per cubic yard, or reduction of its anticipated profit not caused by any act or fault of the Government, but brought about and caused by a hurricane which neither party expected or could anticipate. . . . The plaintiff assumed the risk of the amount of material to be dredged being reduced, as it was, by the hurricane, an act of God, just as the Government would have had to assume the risk of having to pay for an increase in the material necessary to be dredged for the same reason as was the case in Tacoma Dredging Co. v. United States, 52 C. Cls. 447, where a flood caused an increase of 67,000 cu yd. It is a general principle of law that neither party to a contract is responsible to the other for damages through a loss occasioned as a result of an act of God, unless such an obligation is expressly assumed. . ."

ARTICLES ON the preparation of specifications and the protection of legal rights for the guidance of both owner and contractor in avoiding risks of litigation have been presented in recent issues of CIVIL ENGINEERING. In the April and May 1947 issues, Oren C. Herwitz, counsellor at law, New York, N.Y., explained how parties to a contract make their own law and described the legal problems involved in extra-work claims, the specifications of means and methods of construction, and the protection of the legal rights of the parties to a contract litigation. The importance of writing clear, precise specifications and contracts is emphasized by George B. Hills, M. ASCE, and Charles F. Lovan in the November 1947 issue.

Dissenting Opinion Filed

The majority of the Court therefore found the plaintiff not entitled to recover, this opinion being held by two judges. A third judge disagreed and filed a dissenting opinion, stating, in part: "The purpose of the article (Article 4) "is to induce bidders not to increase their bids because of fear of unknown impediments to profitable performance. For the sake of obtaining a lower bid the Government is willing to forego the security of an unconditional promise of the contractor to accomplish specified results for a fixed or computable price regardless of impediments. If the article is to accomplish its purpose, it must mean, in a case like this, that the physical facts which the Government describes in its invitation for bids and which the bidder assumes in computing his bid may be taken as given, so far as they are material to the computation. If, as here, the bid is a unit price bid, the approximate number of units, with regard to the ease or difficulty of their handling, are the things most essential to know in computing a bid.

"If the bidder figures closely, as Article 4 is intended to induce him to do, but finds upon performance that the number of pay units is some hundreds of thousands less than both parties supposed, and that the missing units are those which would have been easiest and most profitable to handle, he in fact losses money though he has

prudently. If the Government knowingly or negligently misled into the same financial plight which he finds himself it would be liable to him in damages. I think that, in general, Article 4 means that the Government promises him equitable treatment when he finds himself in that situation though it was not at fault in getting him there.

"Here the Government survey had shown that approximately 2,894,500 cu yd of pay dredging would be available in the plaintiff's section. In getting that figure it had discounted the gross amount in place by 25 percent because of expected erosion due to the normal currents flowing through the cuts while the dredging was going on. The Government and the plaintiff assumed that the materials to be dredged would have the normal quality of canal bottom materials with which both were familiar from past experience. The plaintiff made his bid. Then came the hurricane and scoured out some hundreds of thousands of pay units of the materials, most of the units being of a quality most profitable to handle, and being removed from a location where they could have been hauled away by the shortest haul. The Government and the plaintiff, still in ignorance of the changed condition, made their contract. As I have indicated, I think that when the true condition was discovered, an equitable adjustment was due under the contract."

What Are "Changed Conditions"?

As stated by the dissenting judge in the Arundel case, the original purpose of the article entitled "Changed Conditions" must have been to induce bidders not to increase their bids because of fear of unknown impediments. Or, as has been said by the Court in another case (96 C. Cls. 148), "If this situation was not within the interpretation of Article 4 the alternative is that bidders must, in order to be safe, set their estimates on the basis of the worst possible conditions that might be encountered. Such a practice would be very costly to the defendant. We suppose that the whole purpose of inserting Article 4 was to induce bidders not to do that."

However in many cases the purpose of this article has been weakened if not entirely destroyed by "escape clauses" in specifications, such as, "Bidders must visit the site and inform themselves as to the conditions and difficulties of the work and no allowance will be made for failure correctly to estimate the difficulties." (84 C. Cls. 84.)

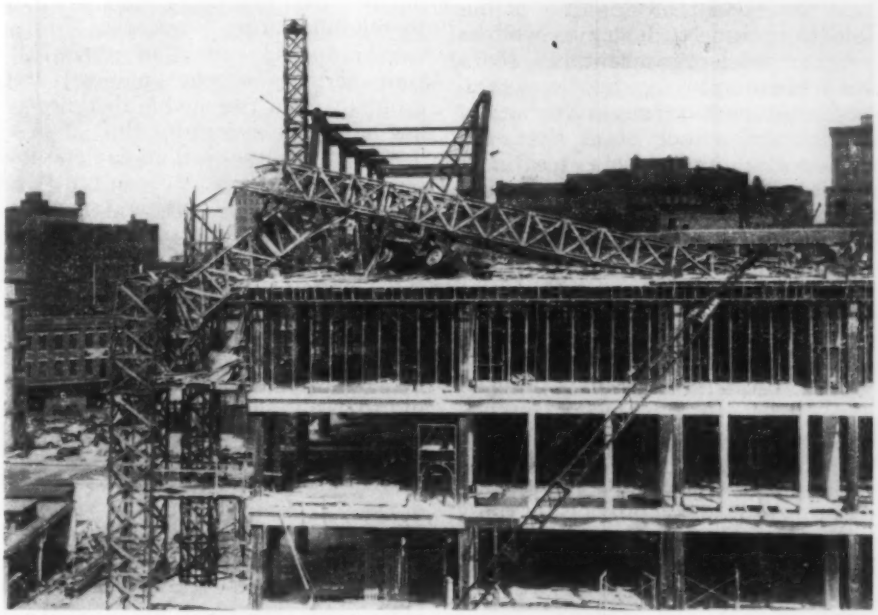
Numerous cases involving claims under "Article 4" have come before the Court of Claims. The decisions of that court, in general, have been based on the doctrine that contractors cannot recover in the absence of fraud or positive misrepresentation on the part of the Government. In the case of the Trimount Dredging Co. (80 C. Cls. 559), the specifications stated, "The material is believed to be soft mud and soft clay with some broken pile ends in the site of the old railroad bridge, but bidders are expected to examine the work and decide for themselves as to its character and make their bids accordingly." The contractor found and removed 752 piles, of which 295 were outside the old bridge area, and also concrete blocks, railroad iron and timbers. The Court dismissed the contractor's claim, stating that the Government, in the absence of fraud or misrepresentation on its part, is not liable for the cost of removing piles and other obstructions not specifically mentioned in the specifications.

In the claim of Triest and Earle (84 C. Cls. 84), the contractor encountered heavy timbers which had been left by another contractor. The Court, in denying compensation, said "It was a case of misfortune on the part of the plaintiff and not a case of misrepresentation on the part of the Government. When the bids were called for and the contract entered into there was no knowledge by the Government of any impediments." Also in the case of the Grier-Lawrence Construction Co. (98 C. Cls. 434), the decision stated, "Absence of disclosure by the Government of subsurface conditions unknown to the contractor is not a ground for recovery . . . where the Government not only did not know, but had no duty to know, such conditions; and where the plaintiff by the exercise of prudence could have known such conditions, having by the terms of the contract assumed the risk of such variations in the condition of the work as actually were encountered."

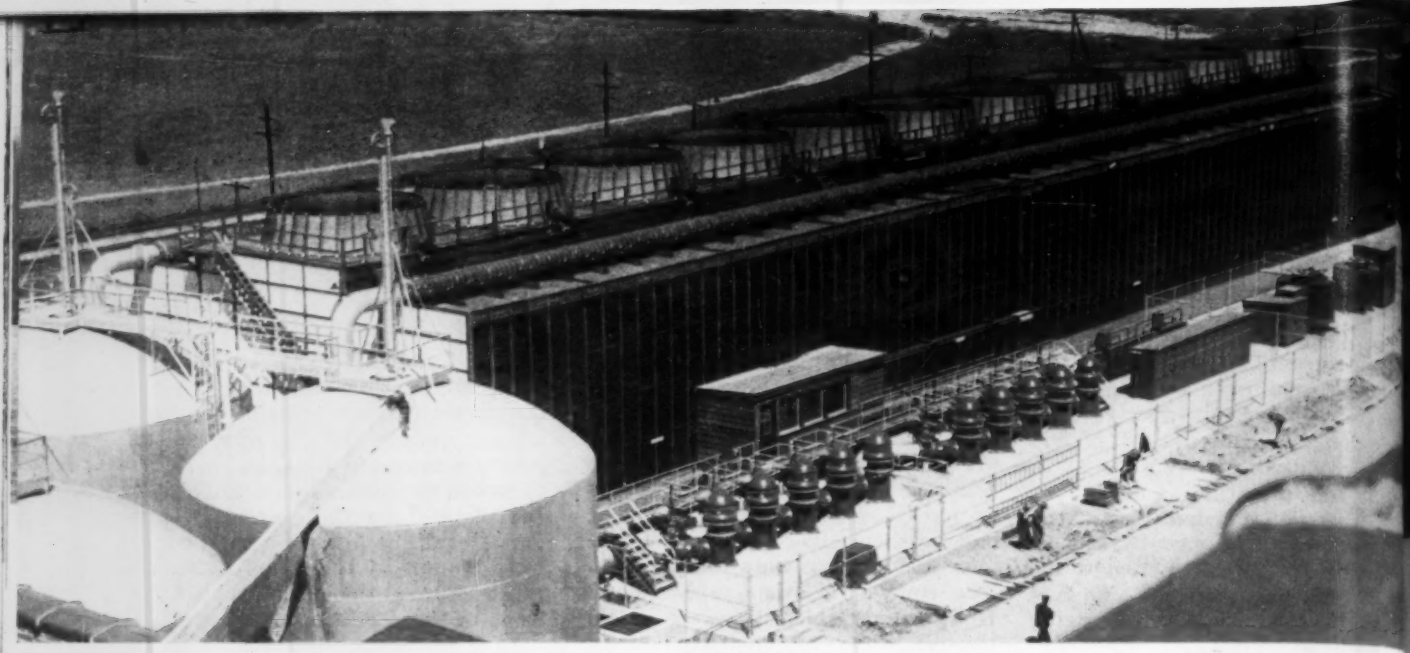
On the other side of the picture, but decided according to the same rule, is the case of John K. Huff (96 C. Cls. 148), where bidders were informed that test pits and other excavations showed no rock and that the nearest rock outcrop was two blocks from the site. The contractor assumed from this that there would be no rock excavation and when this proved to be erroneous he claimed extra compensation. The specification stated that bidders should examine the site and inform themselves

(*Continued on page 84*)

Brisk Atlanta Gale Topples Wooden Hoist Towers



TOPPLED BY 65-MPH GALE, upper sections of two wooden hoist towers come to rest on partially completed building in Atlanta, Ga. Fall of first tower smashed tower bracing and loosened guy wires of second, causing its collapse. Contractor's truck on fifth-floor level is damaged by one of falling towers. Third tower is undamaged. Designing, anchoring and bracing towers to withstand higher wind loads in gale areas can do much to avert construction delays of this nature. (Photograph courtesy of Associated Factory Mutual Fire Insurance Companies.)



MANY INDUSTRIES need services of sanitary engineers to handle water requirements, remove industrial wastes and guard against health hazards. Cooling tower (above) handles 33,000 gpm at plant of American Viscose Corp., Front Royal, Va., in processing water for waste acid reclamation department.

Industry Increases Demand for Sanitary Engineers

EDMOND T. ROETMAN,
Assoc. M. ASCE

Sanitary Engineer, American Viscose Corp., Philadelphia, Pa.

EXPANDING OPPORTUNITIES for sanitary engineers have resulted from the recent broadening of the field to include industry as well as governmental organizations. More firms are employing full-time sanitary engineers to supervise utility distribution, select plant sites, design water and waste treatment plants and supervise sanitation programs. Some of the new outlets for members of this profession are outlined in the following article.

NEW OPENINGS are becoming available in industry for sanitary engineers. In the past the limited outlet for their services was largely confined to governmental organizations such as city, state and federal health departments or to consulting engineering firms working on projects for those organizations. A few also have been employed by privately owned water companies.

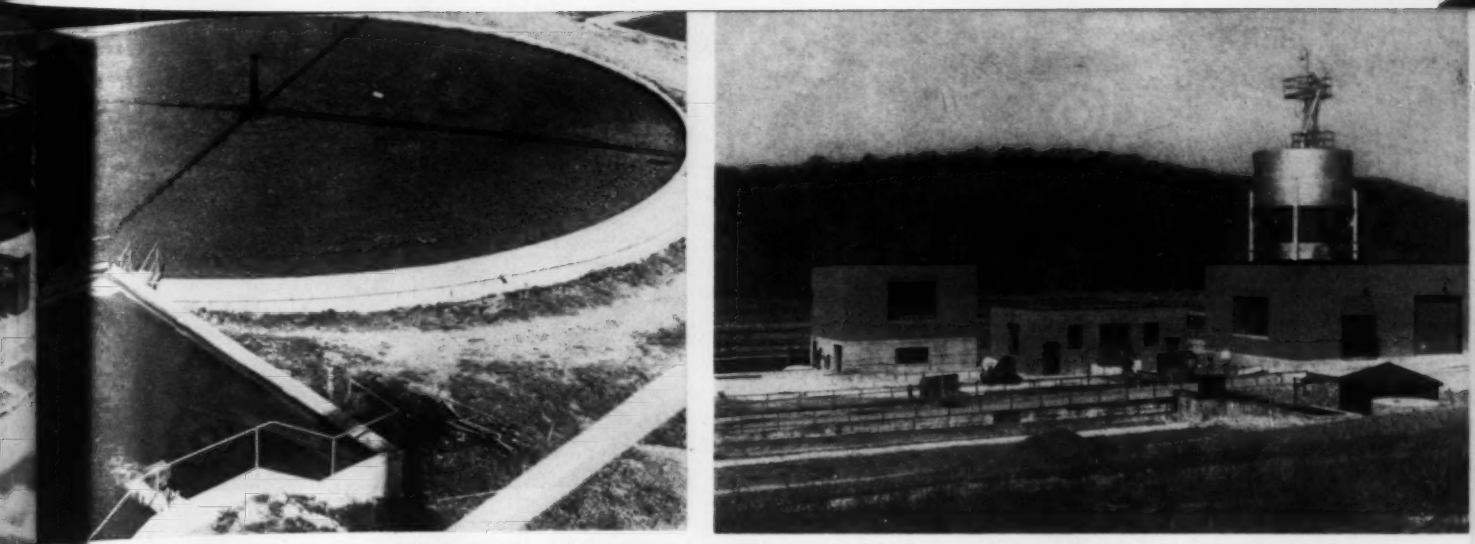
But recently the field has broadened. A few industries have employed full-time sanitary engineers and the trend is for more to follow suit. Industries that can use the services of sanitary engineers to advantage are steel, automotives, textiles, fermentation, railroads, petroleum, chemical and drugs, pulp and paper, food processing, dairies, and tanning.

The capacity of an industry to employ a sanitary engineer is not so dependent upon size of organization as upon other factors such as water requirements, industrial wastes to be handled and health hazards incident to manufacturing processes. Many small industries cannot afford the full-time services of an engineer, but groups within reasonable distance of one another can join for this purpose or their trade associations can employ one or more to act as consultants for their members. This is especially true in the food processing, dairy and tanning industries.

Sanitary Engineers Plan Utilities

A sanitary engineer will find plenty to keep him busy in supervising the utility distribution for his firm. Some industries have as many as eight different types of water that must be distributed through separate systems of mains to points of use. The types of water most frequently encountered are fire, plant process, cooling, drinking, soft and distilled water. In addition some industries have both hot and cold systems for process water and soft water. The design and maintenance of such a multitude of water distribution systems is a big job if properly handled and if not properly handled can become a continuous source of trouble and expense.

Sewers constitute another item that calls for intelligent application of sanitary engineering skill. Here we may find one sewer system handling all the wastes or several separate systems handling different wastes. It is rapidly becoming necessary to consider treatment for industrial wastes and many of these are of such a nature that they must be handled separately. At many old-established plants all wastes are discharged into a common sewer, and when waste treatment plants are constructed the work of resewering the plant to separate the wastes for treatment may cost as much as the treatment plant, sometimes running into hundreds of thousands of dollars. Proper design of the sewer system at the start and intelligent supervision of all future additions can do much to save expensive reconstruction at a later date. In plants of any considerable size, at least three sewer systems are generally needed—one for sanitary sewage, one for industrial wastes that require treatment and one for clean water such as rain and cooling water that does not need treatment. In addition it is often advantageous to separate the acid and alkaline wastes to secure more economical treatment. Occasionally there are special wastes that must be kept separated because they require special treatment or pre-treatment before mixing with the other wastes. In some plants mixing of the various wastes in the sewers is undesirable because of the formation



SEPARATE SYSTEMS handling different wastes are essential in many industries. Expensive reconstruction can be avoided by proper design of original system and intelligent supervision of additions. Trickling-filter system (above, left) treats sulfide waste at American Viscose Corp., Front Royal, Va. Treatment plant (above, right) is for acid waste.

of dangerous or noxious gases that seep out of the various sewers into the manufacturing plant. Six separate sewer systems are not uncommon in some industries, especially those of a chemical nature.

The continuous improvements and changes in processes in some industries require almost constant changes in utility services and sewer systems. This work often reaches a magnitude requiring the full-time services of an engineer and several draftsmen.

Aids Selection of Plant Sites

The sanitary engineer can render valuable service to industry when new plant sites are being chosen. He is qualified to examine and pass on the water supply available, which in many cases is the deciding factor in selecting the site. His examination will cover possible surface and groundwater supplies, with special attention to temperature, quality and quantity. In addition, a pollution survey is now considered necessary to determine the present and possible future pollution of the water supply and the capacity of the stream to absorb wastes to be discharged from the proposed plant.

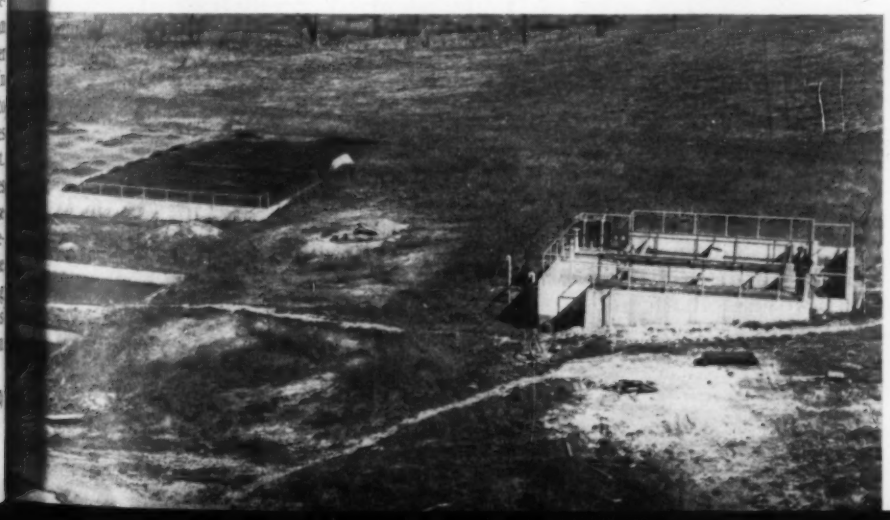
The engineer employed by and familiar with a particular industry can save it considerable capital investment and operating cost by designing a water treatment plant to serve its particular needs. The design of an industrial water treatment plant becomes complicated at times, since the plant may be required to furnish potable water, soft water, distilled or deionized water as well as process water.

Only occasionally, and usually only in large industries, is an engineer called on to assist in selecting a plant site or to design a water treatment plant, but the operation of the water treatment plant furnishes a continuous job. The operation of an industrial water plant calls for close supervision and control to produce the desired quality of water at the lowest cost. The problems encountered are similar to those in the potable water field except that less attention may be paid to bacterial quality and more to chemical characteristics. The very low tolerances of chemicals such as iron, manganese and silica which must be adhered to add materially to the difficulties of treatment. This problem calls for the special knowledge and training of the sanitary engineer. Since many industries have several water treatment plants with capacities of several million gallons a day, the employment of a sanitary engineer to supervise them is easily justified.

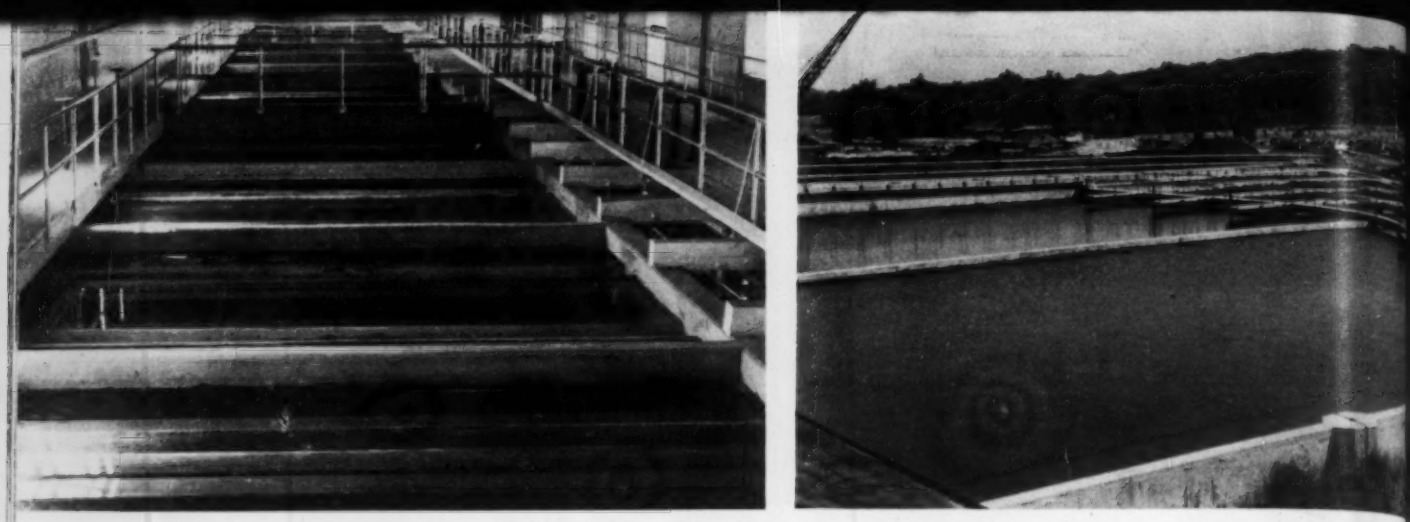
As director of industrial waste treatment, the sanitary engineer becomes a valuable member of the staff. He is capable of studying the problem and developing a treatment procedure that fits the particular industry and plant involved. Often the major portion of industrial pollution abatement is obtained by changes in plant processes to eliminate wastes rather than to treat them, and an engineer working for the industry is in a position to take full advantage of possible process changes. Where treatment is needed, the sanitary engineer can design a plant that will meet requirements with the lowest capital investment and operating costs.

The operation of industrial waste treatment plants is generally a large item in an industry's budget, and proper supervision and control can often mean the difference between profit and loss for the year. In many industries the waste treatment problem is continuously changing as processes and materials used in manufacturing change. A qualified engineer can anticipate these changes and adapt the treatment plant to handle them as they occur, thus preventing many unpleasant situations that would otherwise arise.

One of the most valuable assets a sanitary engineer has from the viewpoint of industry is his ability to discuss stream pollution problems with various governmental officials on common grounds. Those industries that have a sanitary engineer usually find their industry-state relationships much more pleasant because of the engineer s acquaintance with the various officials and the mutual respect and understanding that develop.



DESIGN OF ADEQUATE SANITARY sewage treatment facilities for industrial plant is responsibility of sanitary engineer in protecting health of employees. Other duties include supervision of general plant sanitation and industrial hygiene programs.



WATER SUPPLY MAY BE DECIDING FACTOR in selecting plant site for industry. Sanitary engineer studies surface and groundwater supplies and makes pollution survey. Gravity filters (above, left) and sedimentation basins (above, right) of American Viscose Corp. water plant handle 12 million gal of water per day. Employment of sanitary engineer to supervise such plants is easily justified.

If the sanitary engineer employed by industry should find time on his hands after taking care of utilities, water supply and waste treatment, he can supervise general plant sanitation and industrial hygiene programs that will protect and improve the health of employees. As a rule the cost of maintaining clean sanitary facilities and of controlling health hazards caused by gases, fumes and dusts is more than made up by reduced compensation insurance and increased employee morale.

This article has briefly covered the various ways in which a sanitary engineer can serve industry in an effort to show that he will be an important addition to the supervisory staff. However, to be of maximum value he should have a position high enough in the organization to insure him enough authority to carry out his work properly.

State and Local Public Works Programs Need Advance Planning

PHILIP B. FLEMING
Major General, U.S.A.

Administrator, Federal Works Agency

From a recent report by General Fleming to the President of the United States on the status of public works needs and plans.

IT IS common knowledge that this country has a huge accumulation of construction requirements for new state and local public works. We need highways, schools, hospitals, airports, water systems, sewer systems and many other facilities. We need them to maintain and promote the welfare and safety of the people in our communities, as well as to support commerce and industry.

This deficit has been growing since 1930. It mounted sharply during the war. And even after V-J Day public works yielded priority to the imperative demand for housing and other types of private construction.

There is no exact measure of today's needs for public works, but preliminary surveys and estimates completed and in process indicate that the dollar volume of necessary state and local construction for the next few years approximates $75 billion. But even this figure spread over a 15-year period would call for an annual construction volume of $5 billion—nearly $2^1/_2$ times the 1947 rate of state-local construction.

Some recognition of this need is reflected in proposals for specific state and local construction projects. At the end of June 1947, this backlog stood at $19.9 billion. These figures, gathered by a leading engineering publication, are not complete and they include projects at every level of planning and design up to the point of actual construction.

This awareness is encouraging—until we look a step further and compare these very substantial figures with the volume of plans that are really completed, blueprinted and ready for the contractor.

Here the gap between promise and performance—between recognized needs and completed plans—is dangerously wide. As of June 30, 1947, the value of all completed state-local plans (both with and without federal assistance) totaled only $2.4 billion. This was only $200 million more than the comparable total on December 31, 1946. And all the gain occurred in planning carried out with federal advances—the dollar volume of plans completed without federal help showed a net loss from the comparable total of six months earlier.

Every public works official knows well that it may take from six months to two years to bring proposals to the point where construction can begin. To move from thinking about a project to actual building we must cross a complex maze of engineering, financial and legal work, arrange for land acquisition and design the structure. The last depression taught us that without adequate planning it took many months to put even a handful of unemployed to work on useful public projects.

Quite apart from the possible need for public works to stabilize the construction cycle and help bolster the business cycle, we need more advance planning merely to assure an orderly flow of public construction in prosperous times like the present. Today the effective shelf of plans is equivalent to little more than one year's work at the 1947 inception rate; contracts let by state and local governments during the first nine months of 1947 amount to $1.6 billion.

If public works expand because of the pressure of needs—our shelf may well become depleted. If a downswing in the business cycle should

ll for a broad expansion of public nstruction, we simply would not ave the necessary volume of public orks planned in advance.

But there is a way to bridge this ap and Congress indicated it clearly hen it authorized the Advance lanning Program under Title V f the War Mobilization and Recon-ersion Act of 1944. The funds pro-ided by that program stimulated the esign of projects all over the country. t was justly hailed as the most pro-gressive step we have ever taken to-ard orderly planning of public works.

Under this wise and effective pro-ram the Federal Works Agency made repayable advances to state and local governments for the cost of profes-sional services in preparing drawings and specifications. Advances were made totaling about $61 millions. As a result, plans for over 7,200 useful public works projects are emerging, representing a total cost of some $2^1/_3$ billion dollars of non-federal funds.

This was the finest kind of insurance against waste and haste. But unfortunately the authority to make these advances lapsed with the expiration of Title V on June 30, 1947. This left many local needs unsatisfied and took away the healthy impetus to enlarge the country's reserve of effective plans for public works.

Bills which would restore this opportunity are pending in Congress. Indeed it may well be that many members of both houses are not aware that the advance planning program terminated on June 30. Members may not have realized that the door was swinging shut on many community plans and programs.

In any event, the far-reaching needs of our communities are clearly established. Fundamentally they are human needs, but they have their counterpart in many unsolved problems of business and industry. Only a sound, forward-looking public construction policy can help us meet these needs in the order of their urgency. The keystone for such a sound policy is advance planning which federal repayable loans can stimulate and assure.

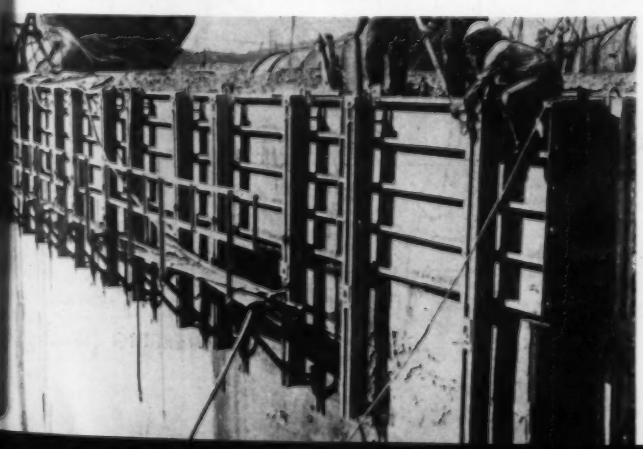
Cantilever Steel Forms Expedite Work on Bull Shoals Dam

TIME- AND EFFORT-consuming operations of building large forms, keeping them true and moving them as heavy concreting work progresses, are alleviated by a new light steel cantilever-type concrete form that eliminates conventional tiebacks and about 60 to 75 percent of the anchors normally used.

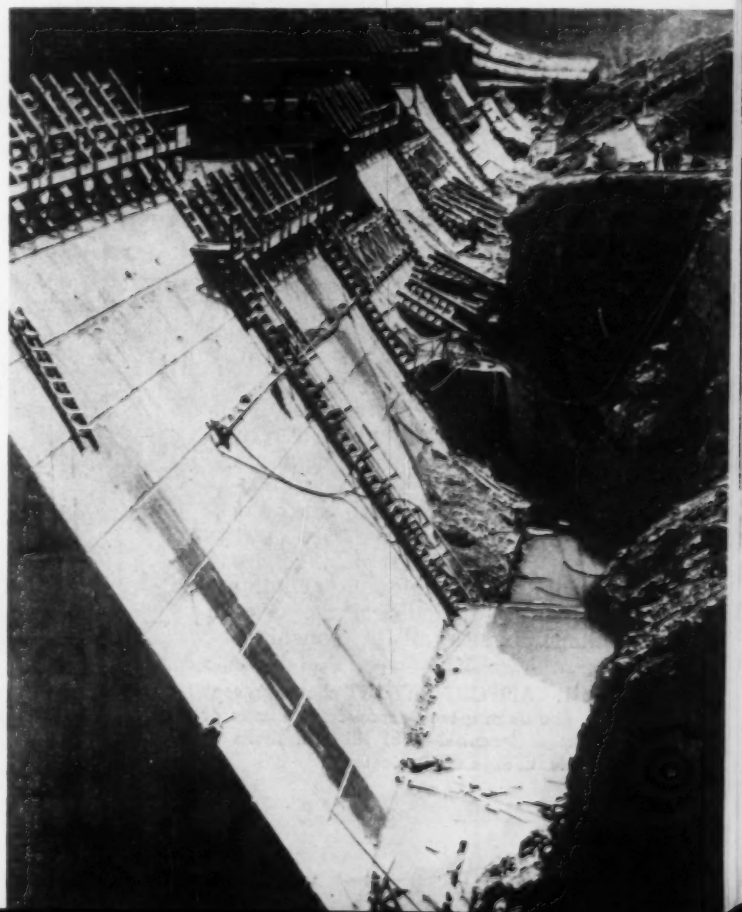
The new cantilever form developed recently by the Blaw-Knox Co. of New York and used in the construction of Wolf Creek Dam in Kentucky, Fall River Dam in Kansas, and East Sydney Dam in New York is based on a new principle which involves anchoring of the form to the block of concrete previously poured.

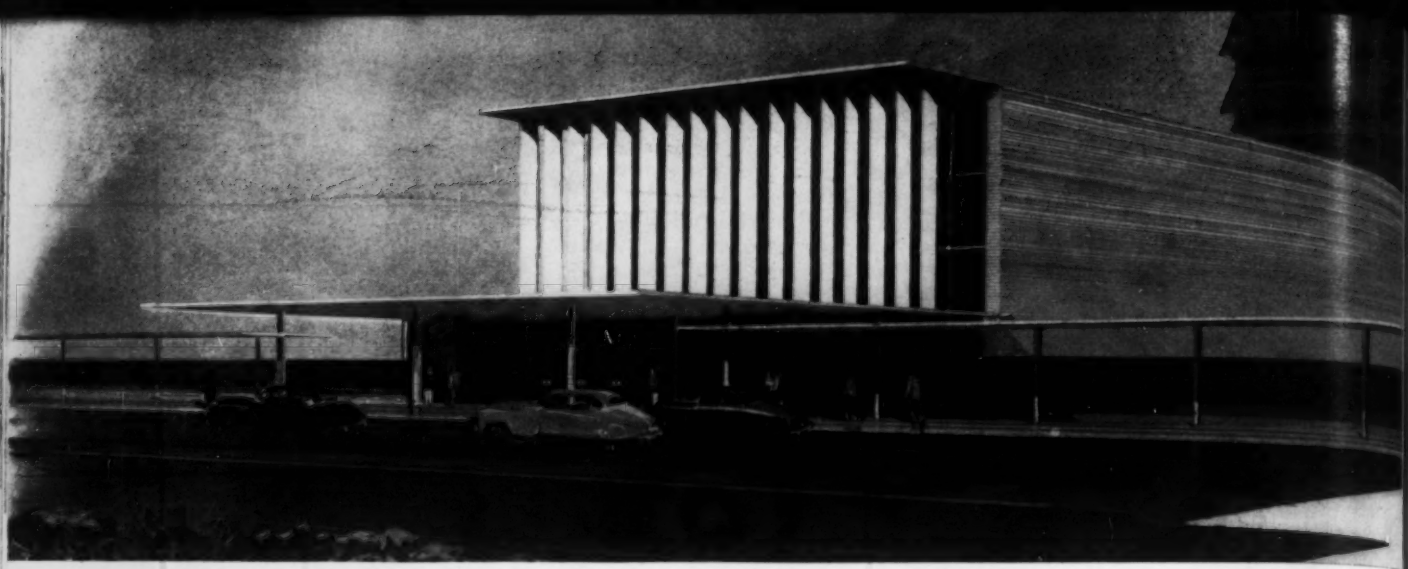
A $22,146,000 contract has been awarded to the Blaw-Knox Co. by Ozark Dam Constructors—a group of nine contractors—for use of the new forms in pouring some 2,500,000 cu yd of concrete in constructing Bull Shoals Dam, part of a flood control and hydroelectric power project on the White River in Arkansas, under the direction of the Corps of Engineers. Nearly 2,000,000 sq ft of surface will be serviced by the new steel forms in this project. The dam will be 2,256 ft long and will have a height of 280 ft from bedrock to the roadway that will traverse it. Total cost of the dam is estimated to be around 47 million dollars. The contractor's bid was $22,146,000 exclusive of aggregates and materials to be furnished by the government.

ANCHORS FOR SUCCESSIVE LIFTS are set by template bolts through top of form. As each list is completed, lower template bolts are removed and form is raised 5 ft to next pouring level where it is again clamped in position to two $1^1/_4$-in. screw anchors embedded near top of newly completed section. Pictured here are cantilever forms used in constructing upstream face of Wolf Creek Dam in Kentucky. Light steel outside work platforms are supported by angle brackets from uprights.



CANTILEVER STEEL FORM, used for first time in pouring concrete of Wolf Creek Dam, Kentucky, is anchored into block of concrete previously poured. Ease of handling and elimination of tie-rods and 70 percent of anchor bolts saves time, labor and materials. Inclined downstream cantilever panels are equipped with bracket outriggers at top forms to facilitate handling of panels. Adjustable curved forms for downstream ogee surface are designed to permit varying curvature.





PHILADELPHIA TERMINAL DESIGN (above) includes modern features such as newsreel theater, rest rooms, hotel rooms, garage and covered parking area. Passengers are not exposed to weather while loading and unloading. Philadelphia won Haire Airport Trophies Award in International Airport category for design plans prepared by Airways Engineering Consultants, Inc. Carroll, Grisdale and Van Alen were retained as architects.

Philadelphia Conducts Extensive Subsurface Exploration Prior to Airport Expansion

ELGIN W. SCOTT, Jr.
Lt. Col., Air Res.
Airways Engineering Consultants, Inc., Washington, D.C.

ALREADY EQUIPPED to handle more than 85 flights daily of five major airline companies and private planes, Philadelphia Southwest Airport is undergoing a face-lifting and expansion program which will greatly enhance its service facilities. The program, now under way, calls for grading and draining 175 acres which comprise the new terminal area. This area is in addition to the present 494-acre airport and a part of the ultimate 2,400 acres proposed for airport use. The building phase of the first construction stage calls for a new 22-gate international terminal building with loading apron, additional hangars and extension of two runways. Three more airlines are expected to make use of the expanded facilities. To eliminate non-uniform settlement and eventual pavement failures the City of Philadelphia and its consultants, Airways Engineering Consultants, Inc., of Washington, D.C., conducted extensive soils tests and analyses in both present and expansion site areas. The tests showed the need for extreme care in placing all fills to avoid the creation of mud waves. The first stage of construction of the $40,000,000 airport is now well under way. When completed, it will be capable of handling approximately twice the present operations of the Washington National Airport.

IN THE CONSTRUCTION of concentrated-load masses such as buildings, bridge piers and docks, undesirable subsurface and foundation conditions may be overcome by driving piles or excavating to rock, but these solutions are not feasible in the landing, taxiing and parking areas of airports because of the extensive areas covered. Providing fill of suitable characteristics and sufficient thickness, placed in such a manner as not to create unstable conditions beneath it by its own weight, is the most logical and economical means of creating stability over such large areas when the existing soil has insufficient bearing capacity. Where necessary, undesirable soil must be removed and such areas backfilled. To determine these factors, extensive subsurface exploration must be undertaken and a careful analysis of results made by competent soils engineers.

Other major air terminals, such as LaGuardia Airport in New York, have developed unequal settlements to the point of requiring costly repairs. Determined to eliminate such future difficulties, the city of Philadelphia and its consultants,

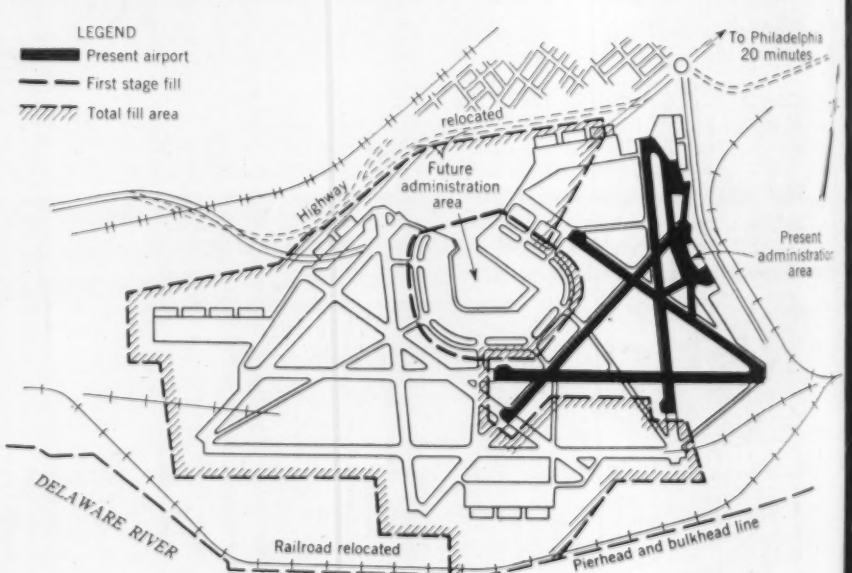


FIG. 1. AIRPORT LAYOUT shows present area and its proposed expansion. Limits of first-stage (terminal-area) fill and limits of ultimate fill area are indicated.

irways Engineering Consultants, ic., Washington, D. C., delayed onstruction until soils investiga- ons and analyses were completed.

The Southwest Airport is located djacent to the Delaware River near s confluence with the Schuylkill iver (see Fig. 1) and most of the ea is now below mean high tide in e river. The soil structure is for e most part silt or silty clay with ery high water content and low bear- g and shear strength. At the time e airport consultants were retained y the city, Elwyn E. Seelye and Co. ere making borings and plate bear- g tests in the present airport area. heir tests indicated that below the xisting fill, principally ashes, a tratum of gravel and sand underlay layer of clay or silty clay of varying hickness. John B. Rulon and Co., etained by Airways Engineering Con- ultants, made subsequent tests at pot locations in the adjacent ex- ansion area, confirming the previous onclusions. These preliminary bor- ngs also served as a guide to the pacing and depth of additional orings necessary before the prepara- ion of detailed plans and specifica- ions for the fill.

Test Holes Drilled at 250-Ft Intervals

According to predetermined plans or stage development of the airport, he first construction phase consists f clearing, filling and draining the ew terminal area. Raymond Con- rete Pile Co. was retained to make further exploration of subsurface onditions in this particular area by rilling test holes at each intersection f grid lines laid out 250 ft apart in oth directions (see Fig. 2). This ork, using three drill rigs, was

FIRST CONSTRUCTION PHASE consists of clearing, filling and draining new terminal area. Euclid truck and loader are part of 85 pieces of equipment used on airport project. Goodyear photo.

started around November 1, 1946, and was finished within seven weeks.

After completion of approximately 15 holes, the logs of the borings and the samples taken from the holes were studied by the engineers and their consultants, Dr. Arthur Casagrande, M. ASCE, and Thomas A. Middlebrooks, Assoc. M. ASCE. Because of the reasonable uniformity of underlying material, it was decided to increase the boring spacing from 250 ft on centers to 500 ft except in spots where buildings were to be located.

Sixty test holes were drilled to depths ranging from 16 to 90 ft, or an average depth of 37.75 ft per hole. Samples were taken from each stratum and more often when necessary to give a full and complete picture of underlying soil conditions. A total of 350 samples were taken, an average of 5.8 samples per boring or an average spacing between samples of 6.5 ft. A graphic representation of the location of borings, the depths of strata and the soil classifications was shown by the illustrated "peg model" (Fig. 3), covering the terminal area with its building sites, auto parking, plane-loading apron and peripheral taxiway.

In a laboratory established at the airport, tests were made to determine water content, plastic limit, liquid limit, plasticity index and mechanical properties of each sample. The results of these tests substantiated previous conclusions regarding the types of soil to be encountered, namely, silt, clay, peat, sand, gravel, cinders and various combinations of all these types. A high water content and low bearing strength prevailed in the surface stratum throughout the area.

The top stratum was generally found to consist of silt or silty clay varying in thickness up to 30 ft. Under it a stratum of sand and

FIG. 2. GRID LINES 250 ft apart serve as guide for exploring subsurface conditions. Because of uniformity of underlying material, boring interval was changed to 500 ft.

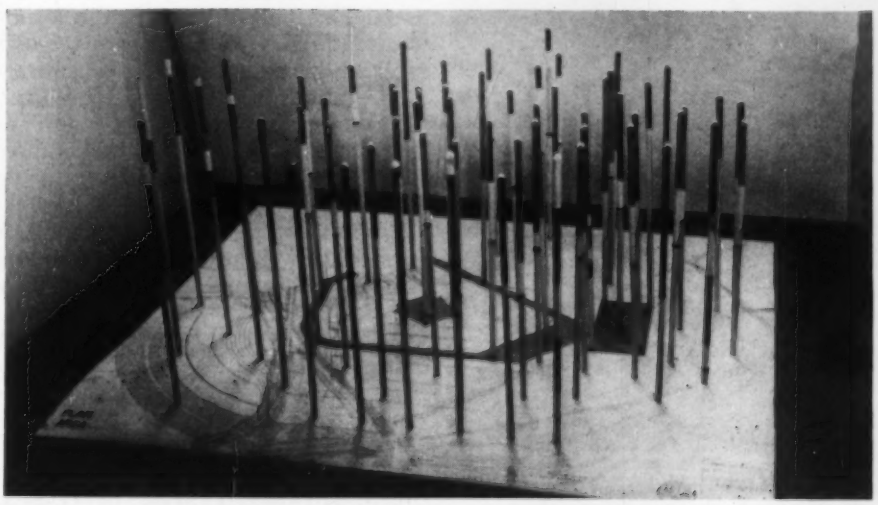


FIG. 3. PEG MODEL shows subsurface conditions in terminal area. With base of model representing El. -60, strata are plotted on vertical scale of 1 in. equals 5 ft. Black and gray shades represent undesirable silts and clays; light shades are sand and gravel. Dark rectangle at right shows location of test fill.

SIMPLE RIG provides means for making test borings in exploration of subsurface conditions in 150-acre expansion area of Philadelphia Southwest Municipal Airport. Preliminary borings serve as guide for spacing and depth of additional borings for detailed plans and specifications for fill. Photo courtesy Raymond Concrete Pile Co., N.Y.

PERIPHERAL DITCH with side slopes of 10:1 is excavated by dragline. Corrugated metal pipe drain is seen at far end of ditch.

gravel varying from 10 to 25 ft in thickness and another generally thin stratum of silt or clay were encountered before entering a stable sand and gravel condition (see Fig. 4). Because of the low shear and highly compressive characteristics of this soil, extreme care had to be taken in placing the fill to avoid concentrated loads. Otherwise there was a possibility of creating "mud waves" (horizontal movements of unstable subsurface soils from beneath the load-creating disturbance and subsequent displacement of surface soils at points of least resistance to such movement).

As called for in the specifications, the existing surface crust and root structure were not disturbed more than necessary. The top soil was not stripped nor were roots grubbed unless they were within 12 in. of the proposed subgrade.

Overload Fill Superimposed

The load imposed by the required fill in the terminal area (average depth of 6 ft amounting to approximately $1\frac{1}{2}$ million cu yd) would in time consolidate the lower strata by forcing out the moisture, but during this period the surface of the fill would be unstable because of non-uniform consolidation resulting from the varying stratum depths and thicknesses. Furthermore it was estimated that a five-year period of settlement and consolidation would be required. To accelerate the consolidation period and to encourage uniformity of settlement, 5 ft of overload fill (approximately 680,000 cu yd) was superimposed on the required basic fill.

"As to the settlements due to the compression of the soft foundation under the weight of the superimposed fill, it is estimated that most of these settlements will develop within a period of two years after the construction of the fill," Dr. Casagrande stated. "If investigations should indicate that locally the settlements will proceed at a much slower rate, it would be possible to accelerate settlement by temporarily overloading such areas with additional fill which is allowed to remain in place until just prior to the construction of the pavement."

For further study of the amount of settlement to be expected under the load and the rate of consolidation, two undisturbed samples were taken at representative locations in Shelby tubes and delivered to Dr. Casagrande's laboratory for testing. The borings were approximately 30 ft deep and as nearly continuous as practicable.

To further verify the laboratory conclusions, a test fill area (part of the terminal area fill) was fenced off and staked for periodic observations by the engineer. In addition to surface stakes, two metal pipes welded to plates were placed on the existing surface before making the test fill to determine what part of the total settlement would take place in the

(*Continued on page 86*)

EXTREME CARE is taken in placing fill to avoid creating "mud waves." Here, 1-in.-dia pipe is driven at test point in test fill. Observations of elevations of top of pipe are taken periodically to determine amount of settlement.

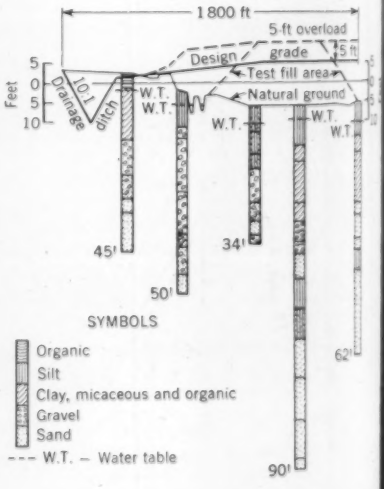


FIG. 4. TYPICAL CROSS SECTION showing present ground elevations, borings, design grade, overload section and test fill. Periodic observations of settlement of test fill are made to verify laboratory conclusions.

Engineers' Notebook

Graphic Comparison of "Specific Strengths"

THOMAS R. C. WILSON, M. ASCE
Consulting Engineer, Madison, Wis.

DETERMINATION IS often desirable as to which of several available materials will, when made into members of specified form and function, have the least weight for a required strength or stiffness; or will have maximum strength or stiffness at a given weight. For direct stress, compression or tension, such determination is made by dividing unit strength or modulus of elasticity by specific gravity or weight per unit of volume since the properties of the member depend only on the unit values and the cross-sectional area.

For strength and stiffness in flexure, or for strength as a long column, properties of the member are determined by higher powers of the dimensions, and division by a higher power of the specific gravity is required. In general, the quotient of the unit strength or the modulus of elasticity by the appropriate power of specific gravity may be termed the "criterion of merit."[1] Table I shows equations for the criterion of merit under various conditions.

A graphic method for comparing materials with respect to values of C was suggested by the writer and used in a recent release from the Forest Products Laboratory.[2] Figures 1 and 2 are reproduced from this release to illustrate the method. Values of S or E are plotted as ordinates against values of G as abscissas on log-log paper. Lines with slopes equal to the powers of G shown in Table I are drawn in the same diagram.

To find C for any material and condition, a line with slope appropriate to the condition is drawn from the point representing the material to the intersection with the vertical $G = 1.0$ and the ordinate of the intersection, as read from the vertical scale, is the value of C; or materials may be compared without determining C. For example, considering materials with grain parallel to span (upper part of Fig. 1), material S_1 is readily seen (by following the proper slopes and with-

[1] This term was used and equations for the criteria developed by S. Livingston Smith in "A Survey of Plastics from the Viewpoint of the Mechanical Engineer," Institution of Mechanical Engineers, *Proceedings*, Vol. 152 (1945), pp. 29–43.

[2] "Mechanical Properties of Laminated Wood," by E. C. O. Erickson, Mimeograph No. R1639, Forest Products Laboratory, Madison, Wis.

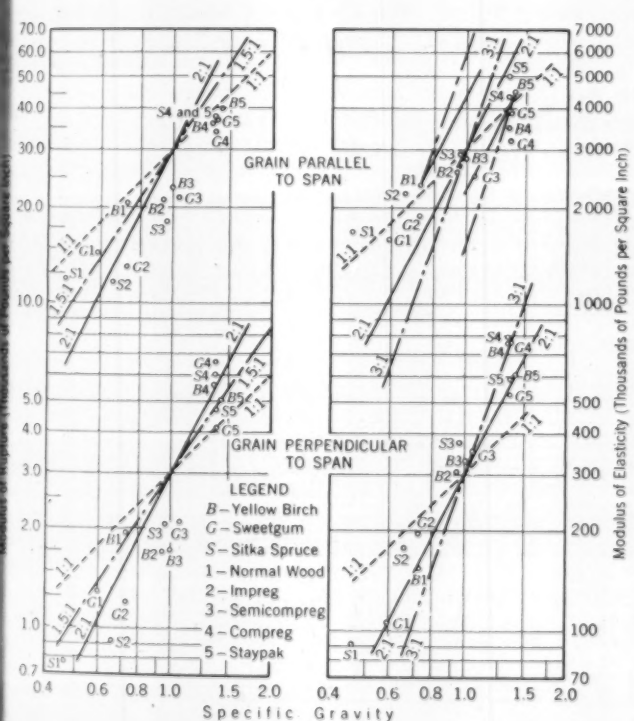

GRAIN PARALLEL TO SPAN
GRAIN PERPENDICULAR TO SPAN
LEGEND
B – Yellow Birch
G – Sweetgum
S – Sitka Spruce
1 – Normal Wood
2 – Impreg
3 – Semicompreg
4 – Compreg
5 – Staypak
Modulus of Rupture (Thousands of Pounds per Square Inch)
Modulus of Elasticity (Thousands of Pounds per Square Inch)
Specific Gravity

FIG. 1. RELATIONSHIP of flexural strength and stiffness to specific gravity of parallel-laminated modified wood.

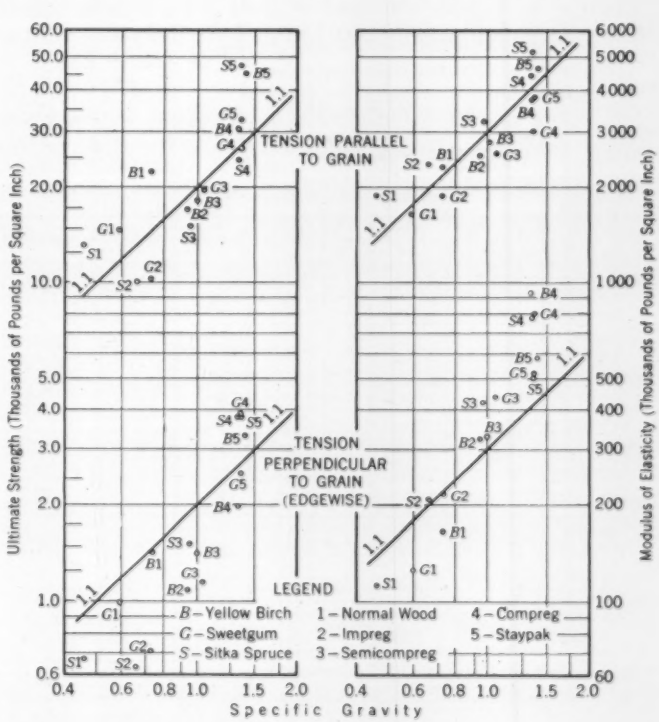

TENSION PARALLEL TO GRAIN
TENSION PERPENDICULAR TO GRAIN (EDGEWISE)
LEGEND
B – Yellow Birch
G – Sweetgum
S – Sitka Spruce
1 – Normal Wood
2 – Impreg
3 – Semicompreg
4 – Compreg
5 – Staypak
Ultimate Strength (Thousands of Pounds per Square Inch)
Modulus of Elasticity (Thousands of Pounds per Square Inch)
Specific Gravity

FIG. 2. RELATIONSHIP of certain tensile properties to specific gravity of parallel-laminated modified wood.

out drawing the lines) to have the highest value of C for both strength and stiffness under condition 2(b) (slope 2:1 for strength or 3:1 for stiffness) or 2(c) (slopes 1.5:1 for strength or 2:1 for stiffness), but is excelled for both strength and stiffness under condition 2(a) (slope 1:1 for either strength or stiffness) by several of the other materials.

Figure 2 affords similar comparisons for tension, and both figures demonstrate the great superiority of "parallel to grain" over "perpendicular to grain" in absolute values of the properties of the materials represented as well as in values of C.

TABLE I. VALUES OF C, THE CRITERION OF MERIT

Condition	Value of C for Strength	Value of C for Stiffness
1. Compression or tension.	$S \div G$	$E \div G$
2. Flexure*:		
a) Depth of member fixed and width varied†	$S \div G$	$E \div G$
b) Width of member constant and depth varied†	$S \div G^2$	$E \div G^3$
c) Depth and width of member both varied to give geometrically similar cross sections†	$S \div G^{3/2}$	$E \div G^3$

S = unit strength; E = modulus of elasticity, G = specific gravity.

* Since the strength of a long (Euler) column is determined by flexural stiffness, the value of C for stiffness for 2(a), (b), or (c) applies, depth in 2(b) or 2(c) being taken as the lesser cross-sectional dimension.

† Dimension or dimensions varied to afford minimum weight for the required strength or stiffness; or to afford maximum strength or stiffness at a given weight.

Graph Solves Cubic Equation When Cardan's Formula Fails

WILLIAM RUSSELL DAVIS, M. ASCE
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IN THE CUBIC, $x^3 + bx + c$, Cardan's formula gives the one only real root when b is positive and also when b is negative and numerically equal to or less than $\left(\frac{27c^2}{4}\right)^{1/3}$. For all other negative values of b, there are three real roots and Cardan's solution fails, for which case one of the three real roots may be readily obtained by use of the accompanying graph.

Compute $j = \dfrac{9c}{\sqrt{-(27c^2 + 4b^3)}}$ and obtain the corresponding value of P from the graph; then compute the root from $R_1 = -(P + 1)\frac{c}{b}$. The sign of this root is the same as the sign of c. A second real root is to be computed from $R_2 = \sqrt{\left(\frac{R_1}{2}\right)^2 + \frac{c}{R_1}} - \frac{R_1}{2}$ and the third root, $R_3 = -(R_1 + R_2)$.

Reasonable care in the use of the graph will give a value that is correct to the third or fourth place.

If a more precise value is desired, proceed as follows: Let R be the value obtained by use of the graph and R', R'', etc., be successive values of greater precision. Then

$$R' = \frac{2R^3 - c}{3R^2 + b}; \qquad R'' = \frac{2R'^3 - c}{3R'^2 + b}$$

etc.

Example: $x^3 - 11.52x + 9.61 = 0$. Then $j = 1.437$, $P = 0.0745$, $R = \dfrac{-(1.0745)\ (9.61)}{-11.52} = 0.8964$. $R^2 = 0.803\ 533$, $R^3 = 0.720\ 287$. $R' = 0.8968$. $R'' = 0.896\ 81$.

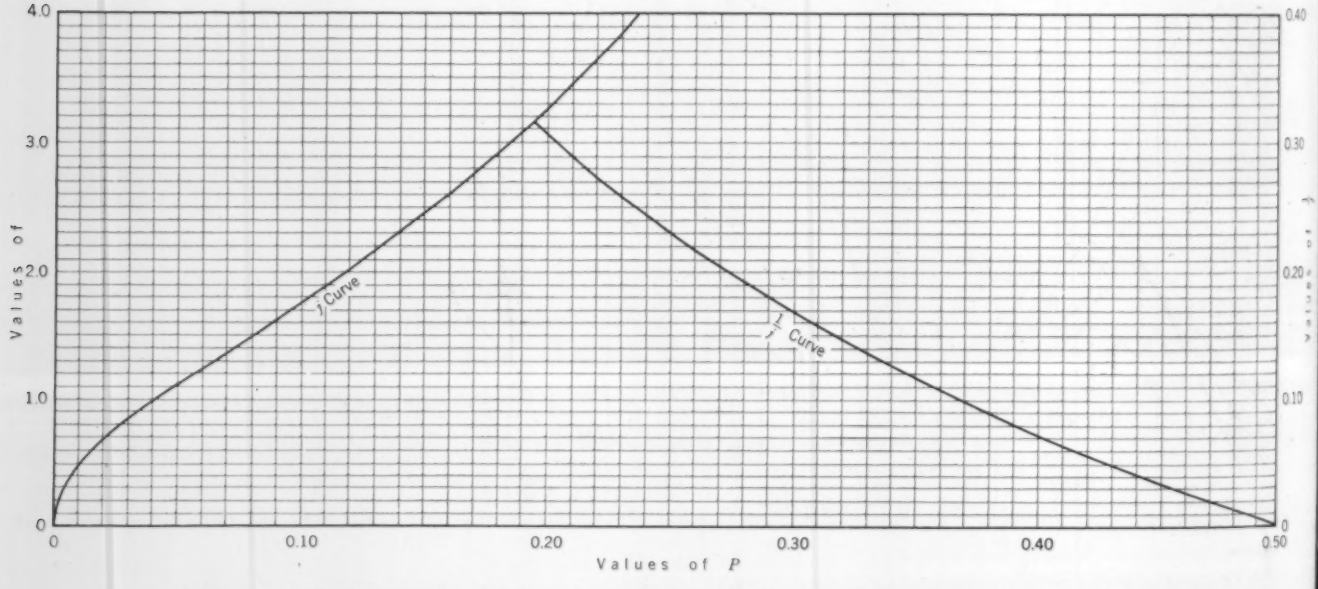

Fig. 1. ONE OF THREE real roots is obtained by use of cubic graph when Cardan's solution fails.

... THE READERS Write

Advocates Separate Allocation of Consumptive Uses of Colorado River Water

TO THE EDITOR: In the last paragraph of Mr. McPhail's paper on the power and irrigation potentials of the Colorado River system, in the August issue, he states that there is not enough water in the river system to permit the development of all possible irrigation projects in the river basin. No one, I believe, will quarrel with this opinion. On the other hand, there may well be disagreement with the Bureau of Reclamation's expressed policy of combining power and irrigation projects to make possible the repayment of irrigation costs that otherwise would be prohibitive.

In a state of nature the total average flow of the Colorado River and all its tributaries was somewhere between 16 and 18 million acre-feet per year. However, there is a common saying in the West that one cannot irrigate with averages; it is necessary to use water in a drought. It is doubtful if an annual consumptive use of more than 15 million acre-feet could be maintained throughout a long series of dry years. Losses from reservoirs must be included in such consumptive uses.

The Bureau of Reclamation, in its report of March 1946, entitled *The Colorado River*, makes almost no reference to evaporation losses from reservoirs, and Mr. McPhail states only that, "except for the increase in evaporation resulting from the formation of reservoirs, power projects would not make consumptive use of the water in the river." From this it might be assumed that such losses were not significant. Actually, almost 10 percent of the total natural flow of the Colorado River and its tributaries is now being lost by evaporation from reservoirs, and if the comprehensive plan sponsored by the Bureau of Reclamation is carried out, such losses will be more than doubled.

Allocation of such consumptive uses should be made separately to power and to irrigation. Allocation of such losses between the Upper Basin and the Lower Basin and between the states of California and Arizona must be made before any new projects are undertaken.

For example, Glen Canyon Dam would be just above Lee's Ferry, the point of division between the Upper and Lower Basins, as defined in the Santa Fe Compact. Evaporation losses from the proposed reservoir might amount to 250,000 acre-ft per year. No land in the Upper Basin would be irrigated from this reservoir, but the power produced would presumably serve the entire region. Will the Upper Basin be given credit for the evaporation loss from Glen Canyon Reservoir in any determination of the minimum quantity of water required by the compact to be delivered at Lee's Ferry, or will such evaporation loss be held the responsibility of the upper Basin? As a further example, the proposed power developments at Bridge Canyon and at Marble Canyon would result in increased evaporation losses of at least 150,000 acre-ft per year. These dams are in the state of Arizona, but the bulk of the power developed will presumably be transmitted to California. Will such losses be charged against Arizona's share of the waters of the Colorado River system, or will California assume part or all of this burden?

In the Lower Basin, evaporation from the reservoir above Imperial Dam is obviously chargeable to irrigation. Evaporation from Lake Havasu, on the other hand, should be chargeable almost entirely to the development of power, even though The Metropolitan Water District of Southern California diverts from this reservoir and water may be pumped from it for delivery into central Arizona. Hoover Dam, of course, was built for flood control, conservation, and power development. As reservoir capacity allocated to flood control is normally empty, evaporation losses chargeable to this item cannot be great. Conservation and regulation for irrigation could have been accomplished with much less storage than was provided. A major part of the great loss from Lake Mead should thus be a charge against the cost of power.

The reservoir to be formed by Davis Dam, now under construction, will result in increased evaporation loss which should be allocated to power, even though this dam is required by the treaty between the United States and Mexico, because the primary and substantially the sole purpose of the reservoir is to re-regulate water released from Lake Mead in accordance with power demands. Evaporation from the series of reservoirs to be formed in the Grand Canyon in Arizona and at sites in southern Utah should likewise be a charge against the cost of development of power, except as one of the dams may necessarily be used both to create power head and for the diversion of water to an irrigation project.

In brief, the development of power along the Colorado River and its tributaries will of necessity result in the consumption of a very substantial portion of the only supply of water available for irrigation in one-twelfth of the area of the continental United States. The value of every drop of such water so lost, which could otherwise be made usable for irrigation and domestic purposes, should be a charge against the cost of power produced on the river in competition with alternate sources of energy. The magnitude of the proper charge may be judged from the fact that evaporation losses from the new reservoirs sponsored by the Bureau of Reclamation for the development of power in the Colorado River Basin will be greater than the total water supply of the Salt River Project in which half of the agricultural wealth of Arizona is produced.

Accordingly, in any determination of the economic feasibility of these power developments that must compete with other present and future sources of energy, the value of the water lost by evaporation from reservoirs, which would not otherwise have been consumed nonbeneficially, should be included in the cost of energy delivered from these plants. On the other hand, electric energy supplied to domestic, commercial and industrial users throughout the region, should not be burdened with part of the cost of extraneous works merely to make a showing of feasibility of irrigation projects on which the cost of water would otherwise be prohibitive. In other words, each physically independent unit in the plan sponsored by the Bureau of Reclamation should justify itself. No unit in the program should have to be subsidized by the many for the benefit of a few.

RAYMOND A. HILL, M. ASCE
Los Angeles, Calif.

[*Editors Note: Mr. Hill's discussion and Mr. McPhail's paper were presented originally at the Society's 1947 Spring Meeting in Phoenix.*]

States Water Works Must Face Critics

DEAR SIR: When an industry or profession gets so self-satisfied that it treats honest criticism as an insult, then that industry or profession is riding for a fall. This self-satisfied attitude has been adopted lately by spokesmen for the water-works industry and that segment of the civil engineering profession connected with the design and construction of the plants producing industrial and municipal water.

By means of nation-wide speech-making tours and the publication of a "white paper," spokesmen for the industry have minimized the effect of pollution on the safety and quality of public water supplies. They have implied that any criticism of the water-works industry or its methods or product is not only unjustified but downright dangerous on the ground that it undermines public confidence in its water supply.

The cause of the furor was an article, entitled "Foul, But You Drink It," which appeared in the September issue of the *Woman's Home Companion*. The article dealt with the effect of increased stream pollution on the problem of producing large quantities of safe water. It pointed out that the job is becoming more difficult year by year and that stream pollution is a major water-supply problem.

Engineers know perfectly well that the water-works men are producing water that meets U.S. Public Health Service standards and that water-borne germ diseases like typhoid are at a low point. The best proof of the efficacy of modern purification practice is the general health of the population with respect to typhoid.

However, before defending the industry indiscriminately and issuing "white papers" to whitewash it, there may be good reason for a factual, unsensational study of water-works design and practice, especially in reference to outbreaks of gastro-enteritis. Studies by the USPHS (House Doc. 266, 78th Cong., 1st Session, pp. 1221–1272) have indicated that combined filtration and chlorination is not nearly so effective in reducing mortality rates due to "diarrhea and enteritis" as it is in reducing "typhoid fever" (p. 1242, *ibid*).

The designers of water works for cities using polluted rivers as a source of supply should take action to handle the virus, or organic toxins, causing enteritis. Officials of water-works organizations, instead of attacking the magazine that published the article, the people who got sick, and the methods of reporting the illness, would do well to reexamine the whole situation with a view to improving conditions and procedures that are found inadequate. There are substantial grounds for doubting whether the test for coliform organisms is sufficient basis for giving a water supply a clean bill of health.

The writer suggests that a Society committee be established to look into the entire matter and that funds be obtained for the USPHS (or a qualified outside agency) to do extensive field work and to offer suggestions for the correction of unsatisfactory conditions or procedures. Let the water-works industry refrain from self-congratulations and resolve to continue to improve its practices. That is the engineering way of meeting criticism. Actions speak louder than words.

R. G. KAZMANN, Assoc. M. ASCE
Columbus, Ohio

Urges Clarification of Income Tax Law Affecting Americans in Foreign Service

DEAR SIR: I was much interested in the article, "Income Tax Requirements Affect Foreign Service of American Engineers," by Edmund H. Lang, Assoc. M. ASCE, in the October number. I happen to have had some foreign experience under the provisions of the Internal Revenue Code, and am about to enter such service again. The present law, as interpreted by the Commissioner of Internal Revenue, would have a considerable effect upon the conditions of this service and the compensation received.

I was employed by a South American republic from 1938 to 1940. On preparing my first income tax return in this employ, I took it to the American Consul for checking and instructions. He informed me that since my salary was derived from foreign sources and since I had resided outside the United States for more than six months of the year, I was not obliged to pay a tax upon it. I simply noted the facts upon my return and they were accepted.

In the tax law of 1942 a change was made. In order to qualify for this exemption, the taxpayer had to satisfy the Commissioner of Internal Revenue that he was a bona fide resident of a foreign country for the entire taxable year (which in all ordinary cases is equivalent to the calendar year), that the services for which he was paid were performed outside the United States, and that the income received was paid by other than the United States or any of its agencies. On the other hand, if the taxpayer is employed in any possession of the United States or stationed there on government service, as in the case of military personnel, or engaged in business in such a possession even for a portion of the taxable year, he pays no tax upon income earned provided that such income amounts to at least 80 percent of his entire income.

The whole difficulty at present lies in the ruling of the Commissioner that the term *bona fide residence* must mean *permanent residence*—that is, that the taxpayer must be making a career of foreign service and must have no intention of returning to the United States, except for vacations and business trips. This is in spite of the phraseology of the law, stating that such residence must be for the entire taxable year and providing no tax upon foreign-earned income in the year that the taxpayer returns to the United States provided he has been non-resident for two years or more, regardless of the fact that he may have been away for only a part of the year in which he returns.

Having a very personal interest in the matter, I visited the Internal Revenue Bureau in Washington and discussed the ruling with an agent. He said that this section of the law is not clear and has given the bureau much trouble. Many persons, including those sent abroad by the government or by business firms, have misinterpreted its provisions and failed to declare their income. The stringent ruling was made to head off illogical claims, but the bureau will judge each case upon its individual merits, so that there is still a chance for tax exemption upon the earnings of a person legitimately employed abroad.

The taxpayer should write to the Commissioner, stating the circumstances of his case, the name of his employer, the class of work that he will perform, the source of his salary, whether he will be accompanied by his dependents, and the probable duration of his absence from the United States, and request a ruling. A copy of the ruling obtained should accompany his next tax return. Under the present law, if the taxpayer enters upon foreign service during any year, he cannot hope to avoid a tax upon his earnings for the remainder of the taxable year. He should have his foreign residence established by or before the beginning of the year. The regulations specify that, once he has established such residence, any number of absences in the United States for vacations or business purposes do not change his status.

Even so, under the Commissioner's ruling, there is a strong chance that foreign salaries may be taxed, depending upon the decision in each case. Thus the Bureau, by this ruling, has largely written its own law, the opportunity being afforded by the defects in the law itself. The agent with whom I talked said that the Bureau would welcome legislation to clarify the section in question.

The ruling, if rigidly enforced, would have a far-reaching effect upon the work of American engineers in the foreign field. Primarily, it would reduce the income of engineers receiving salaries of $15,000 to $25,000 a year by 30 to 40 percent, causing many of them to refuse foreign employment unless guaranteed salaries sufficient to pay the taxes and leave a satisfactory return. This would increase engineering costs to the country seeking to employ them.

If the project does not justify such an increase in engineering cost, the foreign country might abandon it. Or such a country could turn away from American engineers and employ Europeans. This would close the market to use of American goods as well as American labor.

In some cases, foreign countries desiring to employ American engineers on important work of considerable duration may offer them citizenship, and some who consider the attitude of the Internal Revenue Bureau unfair may accept. The American Consul to whom I submitted my first tax return in South America said that the original exemption law had been adopted to keep Americans from becoming expatriates. Some persons living abroad and receiving their principal income from foreign sources had been giving up their American citizenship because of the existing law taxing their income. The ruling of the Commissioner would thus result in a condition that the law was originally adopted to prevent, and the Bureau would collect no income tax upon their salaries.

There remains another possible course of action. A foreign country might refund to an American employee the United States income tax upon his salary or increase his pay so that his net return would not be reduced by the tax. This would be, in effect, a tax upon the foreign country and not upon the employee.

I discussed the matter with the Chief Clerk of the Congressional Joint Taxation Committee, who drafts proposed tax legislation. He confirmed the statement of the Internal Revenue Agent first interviewed, that the law is not clear, has given much trouble, and should be changed. He asked the writer for recommendations, which were compiled and sent in by letter, as follows:

"The existing law affecting taxation of salaries paid to American citizens from foreign sources is stated in the 'Supplement to Regulations 111, Income Tax, Internal Revenue Code, (Sec. 116 (a), (1), (2), and (3),' page 265.

"I believe that it is not equitable to tie in the exemption with the term of the taxable year, since by the accidental circumstance of starting such work at very slightly differing dates, one such employee might have his earnings exempted for an entire two-year period, while another, working for the same length of time, would pay a tax upon his earnings for practically half this period. If such salary is to be tax-exempt, it should be by the reason of the foreign residence and source of income, and not by reason of the dates between which it is earned. I also believe that the necessary bona fide character of the foreign residence may be established by requiring that it be maintained for a reasonable period, say for two years.

"Without attempting to phrase the wording of such an act, therefore, I would suggest that it provide for the exclusion from gross income of earnings of U.S. citizens residing in foreign countries and receiving their pay from sources without the United States (except as paid by the U.S. or its agencies), if the period of employment is two years or more, as evidenced by a contract for his services, a guarantee of salary for such period, by entering upon work estimated to require two years, or other evidence satisfactory to the Commissioner of Internal Revenue. It may be required that such evidence be attached to his first income tax return submitted after entering upon this employment.

"It should also be provided that in cases where a citizen has entered upon such employment in good faith but, after having served for at least one year, is prevented from serving the full two years by reason of death, disabling illness, cancellation of the contract by his employer, completion of the work in less than the estimated time, or from other reasons beyond his control, the Commissioner of Internal Revenue may, at his discretion, waive the two-year requirement.

"The present regulation, to the effect that once the status of bona fide resident of a foreign country is established, it shall not be changed by temporary absences in the United States due to vacations or business trips to the United States should, I believe, be written into the Act."

It is hoped that this letter may initiate action leading to a clarification of the present law or, at least, that it may be of assistance to engineers contemplating entering foreign service.

ERNEST F. ROBINSON, M. ASCE
Winchester, Va.

Bethlehem Is Credited with First Water Works in U.S.

TO THE EDITOR: Readers of CIVIL ENGINEERING may be interested to know that regular operation of the first pumped water works in the United States began in Bethlehem, Pa., in 1755. In this connection, I have done some research into the life of Hans Christiansen, immigrant millwright, who played an important role in the development of a water supply system for the community.

In 1754 the water committee of the Moravian Brethern, who 13 years before had selected Bethlehem as a good site for a settlement because of the presence of an adequate supply of spring water, met to discuss the problem of finding an easier way of bringing water from the spring than by human carriers with yokes on their shoulders. The problem also engaged the attention of Hans Christiansen, who had emigrated to America from Holstein in 1751.

Christiansen observed that water power was available, as an oil and bark mill had been built on the Monocacy Creek close to the spring, and decided that the water wheel could do more work. However, there were other problems to consider, such as the construction of a water tower on top of the hill and of one or more small distribution tanks. There was also the matter of laying pipes to carry the water to the tanks and of deciding what kind of material was available for the pipes. However, construction of the necessary pump constituted the most serious problem.

About this time a West India missionary, John Boehner, was on a visit to Bethlehem. He, like Christiansen, was an ingenious man and interested in mechanical appliances. Boehner made a model of a pump and discussed its merits with Christiansen, who then set about the task of constructing a pump entirely of wood. The piston, 5 in. in diameter, was shaped out of lignum vitae, a dense hard wood.

Meanwhile selected trunks of hemlock, from which water pipes were to be made, were rafted down the Lehigh River from Gnadenhuetten (near the site of the city of Lehighton), a distance of about 30 miles. Christiansen had these logs bored and a tenon formed on one end and the other end mortised. The bore was about 6 in. in diameter, and each log was at least 15 ft long.

While the pump was under construction, a building was erected near the oil mill to house the water wheel that would furnish power for the pump.

The machinery was perfected, a separate water wheel installed, and the pipes were laid. A shingle-roofed wooden water tower, crowned with a weather vane, was built in the "square" (now the site of the Central Moravian Church), as were the smaller distribution tanks.

On May 27, 1755, water was successfully forced up to the water tower, a height of 70 ft, and on June 27 the flow into the tower began. It was a gala day, for nothing in Bethlehem in those days excited public interest so much as the water works. The occupation of the water carriers trudging up the hill from the "well of Bethlehem which is by the gate" was at an end, a tribute to Hans Christiansen, the ingenious millwright. Christiansen died of consumption, as recorded, in Lititz, Pa., on September 15, 1776, and was buried there.

An illustration of the layout of the water works appeared under my name in the ASCE TRANSACTIONS, Vol. 92, 1928, p. 1285.

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Bethlehem, Pa.

SOCIETY NEWS

R. E. Dougherty Inaugurated as ASCE President

MORE DEFINITE COORDINATION and crystallization of the functioning of the Society's national officers and directors, to the end that the Board of Direction can obtain "some better idea of the thinking of the Society in advance of submitting important amendments or of reaching other momentous conclusions," was advocated by Richard E. Dougherty, vice-president, New York Central System, upon his inauguration as President of ASCE.

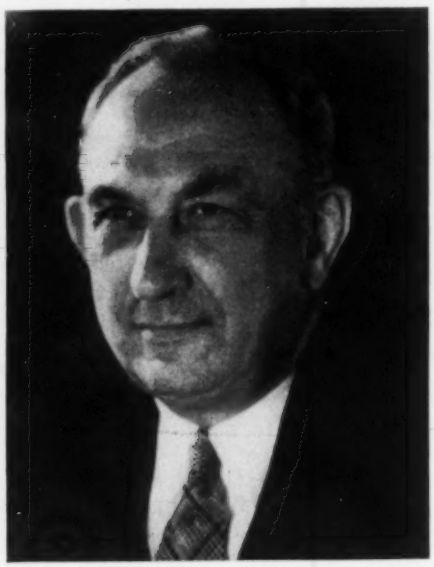
When he took office at the opening of the Society's 95th Annual Meeting in the Hotel Commodore, January 21, Mr. Dougherty made the following brief remarks:

"No man could be more keenly appreciative of the high honor which this Society has this morning conferred on me. Neither could any man be more cognizant of the obligations and responsibilities which that trust imposes. My immediate predecessor, Ed Hastings, and in turn his predecessor, Winans Horner, have indeed set high standards to follow. In fact, that same comment might well be extended to all the Presidents and Past-Presidents with whom I have been associated: Jack Stevens, Malcolm Pirnie, Ezra Whitman, Ernest Black, in the years since 1942, and Robert Ridgway, George Davidson, John F. Stevens, Lincoln Bush, Anson Marston and John Coleman during the years 1928–1929–1930, when it was my privilege to be a Director.

"President Hastings and the 1947 Board may well be proud of having initiated the move which resulted in the enfranchisement of Juniors. There is nothing more important to the Society than its relations with the Juniors and the Student Chapters, and such activities may well be further developed.

"I have no inclination to express dogmatic opinions as to policies which later experience might well prove should be changed. There are, however, certain suggestions which I should like to submit for consideration. The functioning of the Board with the Local Sections and the members, and through the Vice-Presidents in the Zones and the Directors in the Districts, should be more definitely coordinated and crystallized so that the Board could, if possible, obtain some better idea of the thinking of the Society in advance of submitting important amendments or of reaching other momentous conclusions.

"It has always been my idea that the profession of civil engineering should be very broad in its conception and application. To be sure, the fundamentals are technical and I am not minimizing the great importance of the technical work.



RICHARD E. DOUGHERTY
President for 1948

My own thought is that our duties to the profession are much broader and extend to every phase of executive consideration, governmental and otherwise, when our membership is involved. With that objective, it is necessary to work in close cooperation with the other technical and professional societies to accomplish the purposes of the profession and in satisfaction of the trust which I believe the public reposes in us.

"The members of this Society with varied opinions want such things as more consideration for the Local Sections, greater activity in the Engineers Joint Council, attention to the welfare of members, more extensive publications, greater support of the Technical Divisions, Juniors and Student Chapters, and other expansion of activities too numerous to mention. The Engineering Societies Library Board believes that its activities should be expanded.

"In attempting to respond to the various demands of the Society, previous Boards have adopted deficit budgets with, thus far, no adverse result with the exception of depletion of reserves. This cannot go on forever and the 1947 Board adopted the wise decision of balancing its budget and made reductions much to the dissatisfaction of many members. In my opinion they had no alternative. It is of interest to observe that less than 50 percent of those eligible voted on the important question of increasing the dues.

"I believe that the 1948 Board should carefully review all problems and endeavor to reconcile the needs and desires of the Society with the revenues available. It must be remembered the dues have not been raised since 1921 although the ideas of the Society as to its functions have expanded and changed to a vast extent in the intervening period.

"I believe that the days of complacency and happy security when the Society could afford to wait for prospective members to apply, have gone. It would be my suggestion that the Local Sections make strenuous efforts to increase the Society's membership by interesting and inviting applications from the leading engineers in their territories. If the leading men respond, the younger men are likely to follow. It would be my further suggestion that the Local Sections expand their own membership so that it will not remain only about half of the total membership of the Society as at present.

"In behalf of the 1948 Board I ask for your very active help, cooperation and interest."

Each year in the issue of CIVIL ENGINEERING immediately following the Annual Meeting, there appears a biographical sketch of the new president of the ASCE. This year the biographical material concerning Mr. Dougherty is here combined with his inaugural statements in order that the membership may have an opportunity to know a little more about the man who heads the Society.

Born in New York City on February 11, 1880, Mr. Dougherty received his elementary and secondary education in the New York public schools. He then attended the City College of New York for three years and Columbia University for four years, graduating with the degree of

Civil Engineer in 1901. He is a member of the honorary engineering society, Tau Beta Pi, of Columbia. In 1945 he received the Egleston Medal and Citation of the Columbia Engineering Schools Alumni Association for distinguished engineering achievement. He taught at Columbia in 1901 and 1902, and from 1916 to 1920 was special lecturer at Cooper Union.

Associated with the New York Central System since 1902, Mr. Dougherty was recently elected vice president-assistant to the president. He entered the service on the Mohawk Division, located at South Schenectady and Albany, and served as rodman, transitman, and assistant engineer on construction, from 1902–1904. In the years 1904–1905 he was assistant engineer, General Office, New York. From 1905 to 1918 he was in charge of construction, Eastern District, comprising the Hudson, Harlem, Putnam Divisions and New York Harbor, as resident engineer, 1905–1907; assistant district engineer 1907–1910, and district engineer, 1910–1918. From 1918 to 1924 he was designing engineer, Buffalo and East; from 1924 to 1926, engineering assistant to the vice-president in charge of operation, New York Central Railroad, including Ohio Central Lines; and from 1926–1930, engineering assistant to the president, New York Central Lines, including subsidiaries. Mr. Dougherty was elected vice-president, improvements and development, New York Central System, February 1, 1930, and on September 1, 1947, he was elected vice president-assistant to the president.

In addition to general assignments as assistant to the president, he has supervision over engineering activities and maintenance of way standards, real estate transactions, valuation, insurance, development of various problems requiring analysis, consolidations, coordinations, abandonments, etc. He also has supervision over Grand Central Terminal real estate which, in addition to Grand Central Terminal concessions and office buildings, includes other office buildings, apartment houses, and hotels.

During World War II, Mr. Dougherty acted as one of the New York Central's principal contact officers with the Army, Navy, Defense Plant Corp., and other government agencies in locating plants and industries. He also served as principal contact officer with the Transportation Corps of the Army in the organization of four railway battalions of the Military Railway Service, which later served in Africa, Italy, the European Theater, and India. From 1942 to 1945 he was chairman of the New York Central's Research Council for consideration of postwar problems.

In 1946 Mr. Dougherty was elected president of the Lakefront Dock and Terminal Railroad Co., a joint company formed by the New York Central and the Baltimore and Ohio for the construction and operation of a new coal and ore terminal on Lake Erie at Toledo. In the same year the railroads of Chicago now using the four passenger terminals on the South Side—the LaSalle, Dearborn, Grand Central, and Illinois Central—formed the Chicago South Side Railway Terminal Committee consisting of railroad presidents to consider the Chicago Terminal problem, and Mr. Dougherty was designated chairman of the engineering committee to direct investigations and studies.

Since 1935 Mr. Dougherty has been chairman of the Grade Crossing Committee of the Association of American Railroads, acting for all the railroads in cooperation with the Public Roads Administration and otherwise dealing with grade-crossing problems. Mr. Dougherty is also a member of the Committee for the Study of Transportation appointed by the Association of American Railroads to consider postwar problems, and chairman of the executive and operating committees of the Associated Railroads of New York State, handling legislative questions.

A member of the ASCE since 1903, Mr. Dougherty served as Director from 1927 to 1930 and as Vice-President in 1944 and 1945. From 1945 to 1948 he served as a Society representative on United Engineering Trustees, Inc.

His other affiliations include membership in the American Railway Engineers Association, which he served as director from 1945 to 1947, the New York State Society of Professional Engineers and Land Surveyors, and the New York State Chamber of Commerce. Mr. Dougherty served on Mayor La Guardia's Business Advisory Committee and Committee on Ports and Terminals, New York City, and is now a member of Mayor O'Dwyer's Advisory Committee on Port Planning. He is also first vice-president of the West Side Association of Commerce of the City of New York.

Mr. Dougherty has been active in the civic affairs of White Plains, N.Y., where he makes his home. He was on the Board of Education from 1915 to 1935, and president of the Board from 1923 to 1935. He has served as president of the Board of Governors of the University Club of White Plains, and was a member of the White Plains Postwar Planning Commission from 1942 through 1945.

New Officers Installed at New York Meeting

Fifteen Sessions of Technical Divisions Feature 95th Annual Meeting

WITH A TOTAL attendance of almost 2,500, the 95th Annual Meeting of the ASCE got off to a good start in the Hotel Commodore, New York City, on January 26. Discussion of subjects of social and professional importance as well as technical sessions featuring a symposium on the Panama Canal, marked the four-day meeting.

Richard E. Dougherty of New York City was inducted into office as President of the Society at the Wednesday morning business session. Brief remarks made by Mr. Dougherty at his inauguration, as well as a biographical sketch of the new President, are given in the preceding item. Also installed were two Vice-Presidents—Carlton S. Proctor, New York City, Zone I, and John S. Cunningham, Portland, Ore., Zone IV—and six Directors: William McK. Griffin and Edmund A. Prentis, New York City, District 1; Joel D. Justin, Philadelphia, District 4; Julian Hinds, Los Angeles, District 11; Webster L. Benham, Oklahoma City, Okla., District 14; and C. Glenn Cappel, New Orleans, La., District 15.

Honorary memberships and prizes also were awarded at the Wednesday morning session. These awards are the tangible means used by the ASCE to recognize outstanding accomplishments in professional engineering fields. The new Honorary Members are:

John B. Challies, vice-president, Shawinigan Water and Power Co., Ltd., Montreal, Canada.

Hardy Cross, professor of civil eginneering, Yale University, New Haven, Conn.

William H. McAlpine, special assistant to the Chief of Engineers, Washington, D.C.

Karl Terzaghi, professor of the practice of civil engineering, Harvard University Graduate School of Engineering, Cambridge, Mass.

The ten members who received prizes and medals for their outstanding contributions to ASCE publications are:

Norman Medal, Boris A. Bakhmeteff,

professor of civil engineering, Columbia University, New York, and William Allan, dean of the School of Technology, City College of New York.

J. James R. Croes Medal, Thomas R. Camp, consulting engineer, Boston, Mass.

Thomas Fitch Rowland Prize, R. F. Blanks, materials and testing engineer, U.S. Bureau of Reclamation, Denver, Colo., and H. S. Meissner, civil engineer, Materials Laboratory, Bureau of Reclamation, Denver.

James Laurie Prize, Ross M. Riegel, head civil engineer, Design Department, Tennessee Valley Authority, Knoxville, Tenn.

Collingwood Prize for Juniors, F. L. Ehasz, consulting engineer of New York City.

Rudolph Hering Medal, A. L. Genter, consulting engineer of Baltimore, Md.

J. C. Stevens Award, Maurice L. Albertson, associate professor of civil engineering, Colorado Agricultural and Mechanical College, Fort Collins, Colo.

Karl Emil Hilgard Prize, A.A. Kalinske, engineer for Infilco, Inc., Chicago, Ill.

The Wednesday luncheon featured an address by William L. Batt, president of SKF Industries, Inc., and former vice-chairman of the War Production Board. An authority on postwar European problems, having served abroad on several official missions, Mr. Batt spoke on the timely subject, "How Engineering Can Aid the European Recovery Plan." His talk is briefed on page 25 of this issue.

The how and why of converting the Panama Canal into a sea-level waterway, with the present locks and dams eliminated in order to meet the threat of atomic bomb attack, was presented at the Wednesday afternoon session by Col. James H. Stratton, supervising engineer, Special Engineering Division of the Panama Canal. His paper, together with others in the symposium based on the two-year study leading to recommendations for conversion of the Canal, as recently made to Congress by the Governor of the Canal Zone, is summarized elsewhere in this issue, pages 17–23.

As usual the dinner and dance, held in the Grand Ballroom of the Commodore Wednesday night, was a brilliant affair. The return to greater formality and elegance in ladies' attire made the scene especially gala. Impromptu gaiety was imparted by the booted (but not spurred) delegation of engineers from Texas with their special dances and Comanche war whoops.

LADIES COMMITTEE meets with Herbert Ridgway, member of general Committee on Local Arrangements, to plan events of interest to wives of engineers attending Annual Meeting. Seated, left to right, are: Mrs. William S. La Londe, Jr., Mrs. Thorndike Saville, Mrs. William N. Carey, Mrs. Shortridge Hardesty, Mrs. Morris M. Goodkind, Mrs. Roger W. Armstrong, Mrs. L. H. Csanyi, Mrs. Arthur A. Collard. Standing, in same order, are: Mrs. Raymond L. Brandes, Mrs. Edward J. Cleary, Mr. Ridgway, Mrs. Maurice N. Quade, Mrs. Alfred Hedefine and Mrs. John P. Riley.

The Thursday luncheon, arranged under the auspices of the executive committee of the Construction Division, was addressed by a distinguished group of speakers, including Past-President Hastings; D. W. Winkelman, president-elect, Associated General Contractors of America; Bernard J. Gillroy, New York City commissioner of housing and buildings; Rear-Admiral J. J. Manning, chief of the Bureau of Yards and Docks; ASCE Vice-President Carlton S. Proctor; and J. P. H. Perry, vice-president of the Turner Construction Co. Kirby Smith, chairman of the ASCE Construction Division's Executive Committee, served as toastmaster.

The traditional Thursday evening smoker attracted a capacity crowd. An excellent dinner was followed by a program of entertainment, to which the ladies were invited. Other entertainment provided for the ladies included the Thursday afternoon reception, tea, and fashion show in the Century Room of the Commodore.

A talk entitled "Your ASCE," by R. E. Dougherty, new President of the Society, featured a large Student Chapter Conference on Friday afternoon. Also of interest to the group of 250 delegates from Chapters in the Northeastern section of the country was a forum on job opportunities in civil engineering, in which the situation in private practice, public service, and construction was discussed by specialists in the field. The delegates joined in an open forum on activities of ASCE Student Chapters. This discussion was led by Prof. Jewell Garrelts, chairman of the Metropolitan Section Committee on Student Chapters, and Prof. G. Brooks Earnest, chairman, Society's Committee on Student Chapters.

A sightseeing excursion by chartered ferry boat, on Saturday, gave the members an opportunity to view the bridges over the Hudson, Harlem, and East Rivers and the installations of the New York Navy Yard despite near blizzard weather. A box luncheon was served.

Many other activities, both formally planned and spur-of-the-moment, filled the week. Among these were the college reunions, which made use of the presence of so many alumni in the city to schedule luncheons and dinners.

Ten Technical Divisions held one or more sessions. The programs of these sessions are summarized in this issue, pages 17 to 25.

Section's Publication Urges Support for "Loyalty Fund"

UNDER THE TITLE, "65.6 Percent of the Membership," the *Range Finder*, publication of the Indiana Section, ASCE, has the following to say in the lead article of its December issue:

"When the amendment to increase Society dues failed to meet the necessary two-thirds majority, some 65.6 percent of the members who voted cast their ballot in favor of the increase. In order to create additional monies for desirable expenditures other than allocated in a very restricted budget, the Board of Direction has established the Loyalty Fund.

"The Board is to be complimented for its action. It acted on the plurality of the membership, that strong 65.6 percent. That 65.6 per cent are the loyal supporters of their chosen profession. It is that 65.6 percent who are interested in advancing.

"Several Juniors have expressed their willingness to support this amendment if it again comes to a vote now that they have been enfranchised. Therefore we urge that the Board of Direction seriously consider resubmitting this amendment in 1948. In Indiana, 65.1 percent of those who voted, favored the increase in dues. In the meantime, let's support the new Loyalty Fund.

"Withdrawals from the Loyalty Fund shall be made only on the authorization

BADGE OF OFFICE in form of gavel (above) is handed to incoming President R. E. Dougherty by retiring President Hastings at opening session of Annual Meeting in Hotel Commodore, New York.

RETIRING PRESIDENT E. M. Hastings (above, left) presents Honorary Membership award to John B. Challies, vice-president of Shawinigan Water and Power Co., Montreal, while Arthur Surveyer, Hon. M. ASCE, also of Montreal, who presented Mr. Challies to the President, stands at left.

CORDIAL WELCOME (left) into ranks of ASCE Past-Presidents is extended to retiring 1947 President Hastings (at left) by E. B. Black, 1942 President (center), and W. W. Horner, 1946 President.

CREDIT FOR PLANNING Annual Meeting goes to Metropolitan Section Committee on Arrangements. Seated, left to right, are: L. H. Csanyi, Alfred Hedefine, Past-Chairman, M. N. Quade, Chairman, Arthur A. Collard, Ralph W. Atwater, and, standing, Irving F. Ashworth, Raymond L. Brandes, Nomer Gray, Charles B. Molineaux, William S. La Londe, Jr., Brother B. Austin Barry, John P. Riley.

PRESENTATION of medals and prizes is initiated at opening session of Annual Meeting in Ballroom of Hotel Commodore as Sydney Wilmot, Manager of Technical Publications (standing, left), presents William Allan, M. ASCE, and Boris A. Bakhmeteff, Hon. M. ASCE (standing, in that order), for award of Norman Medal. Others taking part in award ceremony are seated at right.

INCOMING BOARD of Direction assembles for its first meeting. Front row, left to right: Edmund A. Prentis, Director, District 1; Joel D. Justin, Director, District 4; William McK. Griffin, Director, District 1; John W. Cunningham, Vice-President, Zone IV; Richard E. Dougherty, President; Webster L. Benham, Director, District 14; Julian Hinds, Director, District 11; Carlton S. Proctor, Vice-President, Zone I; (second row) Daniel V. Terrell, Director, District 9; Frederick W. Panhorst, Director, District 13; William R. Glidden, Director, District 6; E. M. Hastings, Past-President; W. W. Horner, Past-President; C. Glenn Cappel, Director, District 15; William M. Piatt, Director, District 10; Ralph B. Wiley, Vice-President, Zone III; Harland C. Woods, Director, District 3; (back row) W. L. Malony, Director, District 12; Samuel A. Greeley, Director, District 8; Albert Haertlein, Director, District 2; Shortridge Hardesty, Director, District 1; Lewis M. Gram, Director District 7; Roy W. Crum, Director, District 5; Gail A. Hathaway, Vice-President, Zone II; William N. Carey, Executive Secretary.

the Board. Because the integrity of the men selected by us is above reproach and because the intellect and character of these men are of the highest order, the general membership can be assured that any expenditures from the Fund will be investigated wisely. Perhaps the items of most importance are those which will assist the Local Sections, research, and the professional stature of the engineer."

Rated Under New Point Method, Teachers Are Placed in ASCE Compensation Schedule

INCLUSION OF civil engineering teachers' salaries in the ASCE Recommended Classification and Compensation Plan, and utilization of an objective, point-system formula for evaluating teaching positions according to duties, responsibilities and prerequisites, rather than merely by title, were approved by the Society's Board of Direction at its Annual Meeting in New York in January.

Acting on a final report made after a year-long study by its 1947 Committee on Salaries, which in preliminary reports had called civil engineering teachers "distressingly underpaid," the Board adopted the committee's recommendations that:

Teachers appear in the ASCE recommended salary schedule: instructors in Grade 1, with salaries ranging from $2,700 to $3,400, and in Grade 2, with salaries ranging from $3,400 to $4,200; assistant professors in Grade 3, with salaries ranging from $4,200 to $5,100, and in Grade 4, $5,100 to $6,100; associate professors in Grade 5, $6,100 to $7,250, and in Grade 6, $7,250 to $8,600; professors in Grade 7, $8,600 to $10,350, and in Grade 8, $10,350 to $12,600. These grades follow closely those of federal professional employees (see CIVIL ENGINEERING for November 1946, page 510).

Deans of civil engineering schools be provided with rating sheets and other data evolved during the study, for consideration and discussion.

Copies of the committee's report be sent to the Secretary of each of the Founder Societies.

"Teaching salaries should approximate the prevailing rates for practitioners in permanent employment," the committee emphasized in pointing out the need to hold the large number of teachers "who can and will abandon teaching because they cannot live on the salaries paid," and to attract high-grade engineers who could be equally successful in either field.

The question, "Where in the salary scale should teachers appear?" loomed large in its considerations, the committee reported. Its answer is: "The position of full professor and that of division engineer (ASCE Grade 7) demand equivalent prerequisites, duties, and responsibilities. At this stage in teaching and at this stage in practice, the experience already obtained and the technical development already reached are such that the incumbent can thereafter qualify for the highest position in teaching or in practice if he has the opportunity."

Turning to the point values utilized in the study, the committee stressed the fact that "no arbitrary decision has been made in picking the above points of equivalence in the two scales of grades. The practitioner will rate higher in some, and the teacher higher in others, but the score on duties, responsibilities and prerequisites, translated into point values, will be substantially the same."

Under the formula, a maximum of 150 points is assigned to educational background; 150 to previous experience; 400 to responsibilities of the teacher, divided as follows: supervision, 100; policy and methods, 120; public relations, 80; records and reports, 40; and machinery, safety, etc., 60.

In the committee's study, reports were received from 71 of the 104 engineering schools to which rating sheets were sent. In asking the deans to make the ratings, no point values were presented, in order that no influence could be exerted by knowledge of what the ratings might mean in dollars to any individual and that judgment could be centered on requirements for teachers in the various positions.

Acknowledging that spiritual qualities, highly important in teachers, do not lend themselves to point rating, the committee stressed the fact that the factors or characteristics used are designed to rate the position and not the incumbent. The results of the questionnaire distributed by the committee showed the median value of the points assigned to instructor to be 159; to assistant professor, 228; to associate professor, 304; and to professor, 368.

Median salaries reported in these four categories were $2,500, $3,300, $4,000, and $4,600, respectively, as against recommended medians of $3,400, $5,100, $7,250, and $10,350.

Commenting upon the inclusion for the first time of teacher members of ASCE in the Society's recommended salary schedule, the committee asserted:

"The salaries paid teachers have been published recently, and the figures leave no doubt that they should be raised. The publicity that low salaries have received is all to the good, since too often funds are not available for making any increases. Public support must be secured if the money is to be made available. This is equally true whether the source of the funds is a state legislature or the alumni and friends of private institutions."

A. M. Rawn is chairman of the Committee on Salaries, with Scott B. Lilly, vice-chairman; Charles H. Mottier and Paul Weir, members; and Vice-President Gail A. Hathaway, contact member.

Washington Award Goes to Ralph E. Flanders

U.S. SENATOR Ralph E. Flanders, of Vermont, a mechanical engineer, is the recipient of the Washington Award for 1948. Established in 1916 by the late John W. Alvord, M. ASCE, of Chicago, the Washington Award is given annually to an "outstanding engineer, a citizen or resident of the United States, who has ably served human needs."

Administration of the award rests with the Western Society of Engineers, on the recommendation of a commission representing the four Founder Societies and the Western Society of Engineers. Previous recipients include Herbert Hoover, Charles F. Kettering, and Ambrose Swasey, Honorary Members ASCE, Henry Ford, Orville Wright, and Michael Pupin.

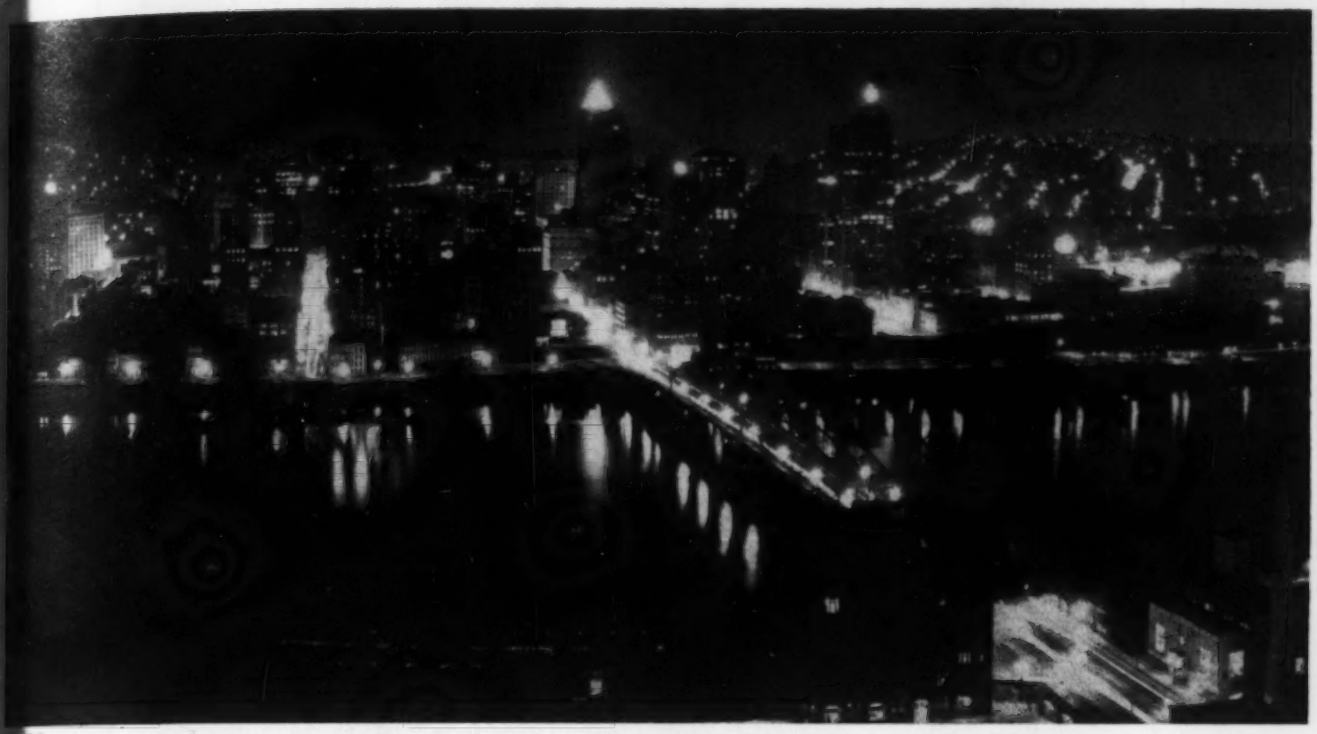
Senator Flanders has been connected with the Jones & Lamson Machine Co., Springfield, Vt., since 1912, and has been its president since 1933. He is also associated in engineering capacities with other machine tool manufacturers and designers. Long interested in economic and social problems, Senator Flanders has written many articles on these subjects. He commenced a term in the United States Senate in 1947.

Presentation of the award is scheduled for February 11 at a dinner in Chicago sponsored by the Western Society of Civil Engineers.

ASCE Director Made Officer of Commission on Large Dams

APPOINTMENT of ASCE Director Joel D. Justin, consulting engineer of Philadelphia, as vice-president of the International Commission on Large Dams, has been announced by Michael W. Straus, chairman of the U.S. Committee on Large Dams. Mr. Justin, who is known throughout the profession for his writings on dam design, succeeds John L. Savage, Hon. M. ASCE, of Denver, Colo., in this office.

The International Commission is sponsoring the Third International Conference on Large Dams which is to be held in Stockholm, Sweden, June 7–9, 1948.



PITTSBURGH, scene of ASCE Spring Meeting, April 7–9, with headquarters at William Penn Hotel, features full round of activities for visiting engineers, including many social and entertainment events, sessions of eight Technical Divisions, and excursions to points of engineering interest. Night view pictured shows famed "Golden Triangle," business section of Pittsburgh. Fill out registration form on page 92.

Pittsburgh Engineers to Be Hosts to ASCE Spring Meeting

Date Set for April 7 to 9

WITH THE COMING of spring, the city of Pittsburgh will fling wide the gates of hospitality to an influx of civil engineers. The program arranged for the Spring Meeting of ASCE to be held in that city, April 7 to 9, will offer every variety of attraction.

Eight of the Technical Divisions have set up programs of current and continuing interest to members of the profession. They are: Air Transport, City Planning, Construction, Highways, Sanitary Engineering, Structural, Surveying and Mapping, and Waterways. A full program of subjects and speakers will be printed in the March issue of CIVIL ENGINEERING.

William Penn Hotel Headquarters

Spacious quarters for the meeting are being provided in the William Penn Hotel, Pittsburgh's link in the Statler chain. The Hotel and Reservation Committee wants to place as many convention goers as possible in the headquarters hotel. To do so requires early registration by those planning to attend. A form is provided so that you can fill out your request for rooms just as soon as you have a chance to talk it over with the wife. **See registration blank on page 92.**

The William Penn will also be the scene of many entertainment events during the days of the meeting. Dinners, parties, smokers and teas are scheduled, along with excursions to points of engineering interest which will give opportunity for sightseeing in one of the world's great steel centers.

Local Section and Student Chapter Delegates to Confer

Conferences have been set for delegates from both Local Sections and Student Chapters. Special programs will be circulated to the groups concerned.

Consideration of Science Foundation Bill Is Urged

NEW CONSIDERATION OF science research legislation is urged in a letter recently sent to President Truman by the presidents of the five constituent societies of Engineers Joint Council, who termed the establishment of a National Science Foundation "a matter of vital national urgency which cannot suffer further delay."

President Truman vetoed the bill providing for a National Science Foundation sent him by the first session of the Eightieth Congress, though he had repeatedly advocated formation of such a foundation. In his veto message, he particularly criticized the projected organization of the foundation on the ground that it would "vest the determination of vital national policies, the expenditure of large public funds, and the administration of important government functions in a group of individuals who would be essentially private citizens." However, the President urged that Congress "reconsider and pass an acceptable bill."

In their letter, the presidents of the five major engineering societies stated their awareness of the differences in viewpoint that have delayed the enactment of science research legislation, but expressed the belief that there is "substantial agreement on the objectives of the National Science Foundation and in the principles essential to successful organization and administration." They also pointed to the need of obtaining the support of scientists and qualified laymen and asked that these groups be given a responsible place in the foundation's affairs.

Satisfaction Through Service Is Theme of Life Members' Recollections

LIFE MEMBERSHIP in the ASCE was achieved by 236 men the first of this year. As always, receipt of Life Membership is accompanied by a desire to look back upon the years of association with the Society and to indulge in self-analysis regarding the contributions made to, and the benefits received from, the organization.

About half of those receiving Life Membership certificates, most of them at appropriate ceremonies arranged by their Local Sections, responded to letters from Col. William N. Carey, Executive Secretary, ASCE, felicitating them on their eligibility to receive the certificates and to enjoy the dues-exempt status of Life Members. In responding to the congratulations extended on behalf of the Board of Direction, and to the hopes that "for many more years to come you will continue to give the Society the benefit of your valued association and support," many certificate recipients protested that they had taken out of the Society more than they had contributed. Typical of the comments are these excerpts:

". . .Then there is regret for opportunities for service neglected for reasons that at the time appeared adequate, but perhaps were not—opportunities which are not likely to come again. But stronger than these memories and regrets is pride in the Society and its services to the profession and to the world. Old in wisdom, but always young in thought and action, may it continue to serve many generations to come!"

"The ancient and noble traditions of the American Society of Civil Engineers, so well sustained by generation after generation, have had a powerful influence on both my professional and personal life."

"Such endeavors as I have made for the Society have indeed been a pleasure on account of the close association with the members. In very recent years it has been a particular pleasure and satisfaction to note the broad service the Society has rendered its membership, through both the officers and the working members."

"At first it startled me that you should consider it a matter of congratulation . . . but as my mind went back to those early days in my life, and I recalled some of the men with whom I have been privileged to associate through my connection with our distinguished Society, I saw clearly that you are right. It is indeed a matter for hearty congratulations that all those years I have been privileged to enjoy the many advantages which membership in our Society brings. Some, I understand, consider these advantages to consist of just four things—the TRANSACTIONS, PROCEEDINGS, CIVIL ENGINEERING magazine, and the local meetings. Of course such a valuation is absurd, for these four things, valuable as they are, are merely the tangible advantages which the Society gives to us. The intangibles, which vary with different individuals, are beyond price. The more a member interests himself in Society affairs, the greater these intangibles become."

"Time passes so fast that I really had no idea I was anywhere near the date when I would qualify for a Life Membership, but now that the time has come, I can only say that I am happy to have been a member of the Society for such a long and continuous period. Also, that my interest in the Society will always continue. The association has always been very valuable to me, and has proved a great inspiration in my work."

"My membership has meant a great deal to me through the years, although I have not been as active as I should like to have been. . . . It is gratifying to note that the Society has been much more progressive in recent years. . . ."

"It hardly seems more than yesterday that I was so elated over my admission as an Associate Member. . . . The 35 years are more like 35 months, and this is probably due to the field in which we labor where every day is a new adventure and the word monotony is not known. The steps which the Society is now taking to have engineers give a greater interest in civic and political life will be successful."

Life Members on January 1, 1948

Comfort Avery Adams
Daniel Wesley Albert
Alexander Allaire
James Pierrie Alvey
Edward Robert Armstrong
Louis Evans Ayres
William Jones Barden
George Harmon Bayles
John Edward Bebb
Robert Burns Haldane Begg
Nathan Benedict
Ralph Robert Benedict
William Bryant Bennett
John Cecil Black
Alexander Blair
Conrad Meuly Blucher
Frank Charles Boes
Haig Milton Boyajohn
Ealy Grannis Briggs
Dudley Seymour Bright
Joseph Hugh Brooking
John Maughs Brown
Ralph Budd
Oscar Harold Bundy
Joseph L. Burkholder
Myron Carlos Burr
Wayne Joseph Burton
Drury Butler
John Richard Cahill
Charles Edward Cate
George Moseley Chandler
Warren Winthrop Chapin
Wayne Almon Clark
Sheldon Byrne Clement
Abraham Burton Cohen
Charles Judson Colgan
Stafford Xavier Comber
Harold Conkling
Robert Mavin Cooksey
William Pitcher Creager
Foster Baldwin Crocker
Roy Winchester Crum
Edwin Sanford Cullings
Arthur Culver
Pinkney Edward Cunningham
Robert Curtis Cutting
Ralph Bruére Daudt
Wilbur Ward Davis
Charles Edwin Dexter
Frederick William Doolittle
George Evelyn Doyen
Walter Louis Drager
Fred Calvin Dunham
Allan Theodore Dusenbury
John North Edy
Clarence Eugene Ellsworth
Morris Cable Emanuel
Rollo Guy England
Frederick William Epps
Erik Theodore Eriksen*
James George Esch
Thomas Willard Espy
Clesson Herbert Field
Frank Preston Fifer
Stanley Phister Finch
John Kramer Flick
Nicolay Knudtzon Fougner
Charles Kirby Fox
Edgar Raymond Frisby
Willis George Frost
David Smith Gendell, Jr.
Norman Paul Gerhard
Frank Gilleltn
William Goldsmith
Samuel Arnold Greeley
John Huston Clark Gregg
Ernest Edmund Grimes
Joseph Watson Gross
George Hagbart Guerdrum
Willard Adams Guild
Homer Huston Haggard
Ward Hall
Eugene Erwin Halmos
Charles Augustus Handeyside
Harvey Lockhart Handley
Sidney Twichell Harding
George Foster Harley
Richard Ambrose Hart
Gage Haseiton
John Edward Hayes
Daniel Carlos Hayne
John Strider Hess
Floyd Sinnock Hewes
William Heyman
Thomas Felix Hickerson
Luther Romberger Hoffman
Clarence Decatur Howe
William Glenn Hoyt
Ellis Hudman
William RichardHughes, Jr.
William Whitehead Hurlbut
Jacob Louis Jacobs
Edwin Warley James
Alfred Jones
Owen Meriwether Jones
James Carey Jordan
Samuel Arthur Jordan
Geary Kimbrell
Edward Dyer Kingman
Frank Alvah Kittredge
Roy Alton Klein
Frank Norman Kneas
James Henry Knowles
Ernest William Kohl, Jr.
Clarence Herbert Kromer
Frank Elmer Lamphere
Martin Philippe Lauer
George W. Cass Lightner
Mark Linenthal
James Bennett Lowell
James Duncan Knapp Lyman
Alexander Sydney Lynch
Charles MacDonald
Stanley Macomber
Carl Armor McClelland
Thomas George McCrory
Joseph Newall McKernan
Henry Lyndon McMillan
Carroll Lamb Mann
George Miles March
Claude Percy Marsh
Charles Christopher Martin
Daniel Howard Martin
Evan Search Martin
Lewis M. Martin
Frank Milton Masters
Richard Mather
Edward John Mehren
Hugh Miller
Charles Rea Moore
Ben Stogden Morrow
Ernest James Newton
John Robert Nichols
William Hogarth Robertson Nimmo
John Alexander Norris
L. Oesterblom
Day Okes
Charles William Okey
Robert Franklin Olds
Ole Kjeld Olsen
Wallace Cromwell Allen Palmer
Dorsey Julian Parker
Ralph Leroy Parshall
Harry Gordon Payrow
Boykin Witherspoon Pegues
Howard Eastwood Phelps
John Louis Pickles
Herbert Carleton Poore
Robert Joseph Potts
William Jenner Powell
Bernard Herman Prack
Andrew J. Provost, Jr.
Walter Putnam
Frank Louis Raschig
George William Rathjens
Leroy Norman Reeve
Cecil Latta Reid
Glenn Vernon Rhodes
Rowland Grenville Rice
Charles Potter Richardson
John Jefferson Richey
Warner Irelan Risley
Harry Robinson
William Henry Robinson
Thomas Walton Roby
Joseph Eugene Root
Joseph Jacob Rosedale
Robert John Ross
Alexander Allen MacVicar Russell
Verney Warren Russell
Edgar Kingsbury Ruth
George Arthur Sampson
Walter Max Sanger
Francis Raber Schanck
George Schobinger
Fred C. Scobey
Percy Allen Seibert
John Archibald Shaw
Percy Augustus Shaw
Charles Edward Smith
Chester Kitch Smith
Clarence Urling Smith
Herbert Yates Smith
James Elmo Smith
John Thoms Smith
Clarence A. Snider
Russell Howard Stalnaker
James Gordon Steese
John Bernard Stein
Roe Loomis Stevens
John Dickson Stevenson
Harry Stock
Edward Charles Stoek
Samuel Edwin Stott
Nelson Taylor
Jonathan Ernest Tol
Clarence Lionel Todd
Frank Thorn Townsend
Frank Johnson Treiber
Hubert Southwick Tu lock
James Tyler
Benjamin Franklin Va dervoort
Harry Stewart Va Scoyoc
Nathan Thomas Veatch
Edward George Walker
John Abbet Walls
Thomas Robert Walter
James Olin Wanzer
Elwin Streeter Warner
Frank Edwin Washburn
William Lawren Waters
Charles David Watson
Vernon Gregg Watters
Royal Sylvester Webb
Walter Wallace Weir
Wade Clarence West
Robert Clark Wheeler
Robert Culin White
Chester Greenhalgh Wi ley
Edward Charles Wild
Allen Rutherford Wilco
Thomas Harrison Wi chester
Harland Clark Woods
William Gordon Woo folk
Stanley Hubert Wright
Charles Wuest, Jr.
Howard McClymon Yost

* Deceased.

...sure, and will redound to the credit of the Society and its members. What is more, it will bring about a better world in which peace will be a certainty."

"The years have been crowded with most interesting engineering designing and development work. There seems to be no letup and the future has more possibilities than all the past as far as I am concerned. I do not like to think of the time already served but of the developments yet to be reduced to a practical basis."

"Your notification that I had lived and paid dues so long...was something of a shock. I hadn't realized (and I don't think I will admit it yet) that I belong with the elders."

"Although I have been fairly active in Society affairs, I have received much more than I have put into it."

"After 34 years of membership in the Society one cannot fail to be impressed with the splendid accomplishments of the organization and the high attainments, professionally and otherwise, of the personnel comprising it."

"It will always be regretted by me that an active part in the work of the Society has been denied me. I hope that my small contributions have been valuable and that the future may present opportunity for doing something more than paying dues and voting."

"While my activities in the work of the Society have been relatively small, the benefits I have received from my membership and my associations have been very great indeed."

"As 1912 seems only about last month, it will probably take a little time to come to full realization of what it (Life Membership) all means."

"...I still enjoy the publications, although I have been out of the practice of the profession for very many years."

"I do appreciate your nice letter and certainly do not intend to let my efforts toward the betterment of the ASCE diminish in any way...."

"I have enjoyed rendering what little service I could to the profession since that is about the only way you can repay what you receive during your early years. You never can return the favor to those who helped you, but perhaps one can do something toward liquidating the obligations by passing the service on to those who are younger."

"I have always treasured my membership because of the Society's high professional standing and because it has always held itself above partisanship, strife, and bickering that so many organizations fall into. It is my wish that the Society continue its present high standard in the entire field of its activities and I shall always be interested in its progress and achievements."

NOTES FROM THE *Capital*

E. LAWRENCE CHANDLER, M. ASCE
Eastern Representative, ASCE

IN THE FIRST few days of the second session of the 80th Congress several legislative bills of importance to engineers came to the forefront.

It will be recalled that S. 526, which would have established a National Science Foundation, was vetoed by President Truman after having been passed by both Houses of Congress in the first session. H.R. 4852, a corresponding bill, has been introduced in the current session by Congressman Priest. This bill provides that the director of the Foundation be appointed by the President with the approval of the Senate, and this removes the grounds for the principal objection raised by the President in his veto of S. 526. Like its predecessor, it includes research in engineering as one of its objectives and should receive the support of engineers.

H.R. 3342, the Mundt Bill, which provides for the international interchange of "persons, knowledge, and skills" and for "public dissemination abroad of information about the United States, its peoples, and its policies" was passed by the House in the first session but never came up for debate in the Senate. It was recommitted to the Senate Committee on Foreign Relations and again has been reported out to the Senate. Prompt action is anticipated.

Inasmuch as the District of Columbia is the only spot remaining in the country without any law covering the registration of professional engineers, it is of interest to note that Congressman Carl Hinshaw, Assoc. M. ASCE, has introduced H.R. 4884, the "Professional Engineers' Registration Act." This bill is the result of long study by a committee of the District of Columbia Council of Engineering and Architectural Societies and has the endorsement of 15 constituent organizations of the Council.

It is probable that development of the St. Lawrence River will again come up for action during the present session of Congress. S.J. Res. 111 has been reported to the Senate by the Committee on Foreign Relations.

Tellers Report on Final Ballot for 1948 Officers

January 14, 1948

To the Ninety-Fifth Annual Meeting
American Society of Civil Engineers

The tellers appointed to canvass the Ballot for Officers of the Society for 1948 report as follows:

For President:	
Richard Erwin Dougherty	7,593
Scattering	13
Blank	16
For Vice-Presidents:	
Zone I	
Carlton Springer Proctor	7,545
Scattering	9
Blank	68
Zone IV	
John Wilbur Cunningham	7,558
Scattering	11
Blank	53
For Directors:	
District 1 (two to be elected)	
William McKenna Griffin	7,555
Edmund Astley Prentis	7,561
Scattering	11
Blank	117
Total votes registered	15,244
Total ballots canvassed	7,622
District 4	
Joel DeWitt Justin	7,568
Scattering	3
Blank	51
District 11	
Julian Hinds	7,572
Scattering	7
Blank	43
District 14	
Webster Lance Benham	7,543
Scattering	17
Blank	62
District 15	
C. Glenn Cappel	7,566
Scattering	1
Blank	55
Ballots canvassed	7,622
Disqualified ballots withheld from canvas	140
Total number of ballots received	7,762

Respectfully submitted,
GEORGE T. GILMAN, *Chairman*
JAMES D. PARSONS, *Vice Chairman*

W. H. Dieck	Howard Holbrook
Rudolph Evers	H. F. Hormann
Francis B. Forbes	Harry Newman
George H. Harp	Frederick W. Ockert

Tellers

NEWS OF LOCAL SECTIONS

Scheduled ASCE Meetings

SPRING MEETING

Pittsburgh, Pa., April 7–9
(Board of Direction meets April 5–6)

ANNUAL CONVENTION

Seattle, Wash., July 21–23
(Board of Direction meets July 19–20)

Coming Events

Florida—Meeting at the Hotel Seminole, Jacksonville, February 12, at 7 p.m. G. E. Schofield, chief chemist of Rayonier, Inc., Fernandina, Fla., will speak on the subject, "From Southern Slash Pine to Finished Rayon."

Maryland—Meeting at the Engineers Club, Baltimore, February 11, at 8 p.m. Preceded by cocktails at 6, and dinner at 7.

Metropolitan—Meeting in the Engineering Societies Building, New York, February 18, at 8 p.m.

Northwestern—Dinner meeting at the Minnesota Union, University of Minnesota, February 2, at 6:30 p.m. There will be a symposium on railroads by representatives of the Great Northern Railway, the Northern Pacific, and the Chicago, Milwaukee, St. Paul & Omaha Railway.

Philadelphia—Joint meeting with the metropolitan Philadelphia chapter of the American Public Works Association at the Engineers Club, February 10, at 7:30 p.m., preceded by good-fellowship dinner at 6 p.m. Illustrated talk on the Port of New York Authority by Roger H. Gilman, assistant to director.

Sacramento—Meeting at the Elks Club every Tuesday at noon. No meetings on holidays; special meetings as announced in the "Engineerogram."

St. Louis—Luncheon meeting at the Hotel York, St. Louis, February 23, at 12:15 p.m.

Seattle—Meetings are held the fourth Wednesday of every month at the Engineers Club, Seattle, at 7:30 p.m.

Tennessee Valley—Meeting of the Chattanooga Sub-Section at the Patten Hotel, Chattanooga, March 9; smoker at 5:15 p.m., followed by a dinner and program beginning at 6 p.m. Regular monthly meeting of the Knoxville Sub-Section at the S & W Cafeteria, Knoxville, February 11, at 5:30 p.m.

Texas—Luncheon meeting of the Dallas Branch at the Adolphus Hotel, Dallas, March 1, at 12:15 p.m.

Virginia—Joint meeting with the Central Virginia Engineers Club at Ewarts Cafeteria, Richmond, February 20, at 5:45 p.m.

Recent Activities

CENTRAL ILLINOIS

UNPRECEDENTED OPPORTUNITIES exist for the young engineer just starting his career, Loran D. Gayton, assistant city engineer of Chicago, told members of the Section at a recent joint meeting with the University of Illinois Student Chapter. Mr. Gayton presented some of the highlights of his own engineering career and gave an insight into the many problems, both technical and personal, that a practicing engineer may expect to face. Earl D. Dryfoose, road engineer for the Illinois Division of Highways, described a recent trip to Europe at a joint meeting with the Illinois Association of Highway Engineers, the Illinois Society of Professional Engineers, and the Springfield Engineers Club.

CENTRAL OHIO

ASCE DIRECTOR Daniel V. Terrell attended a recent meeting and outlined current Society activities. In the discussion that followed his talk, the Section unanimously carried a motion recommending that the Board of Direction initiate action as soon as possible to reintroduce the dues-increase amendment to permit the Juniors to express their opinion on the matter. New officers for the Section, installed during the meeting, are: Carl C. Walker, president; Clarence D. Bowser, first vice-president; Joseph F. Barbee, second vice-president; and Howard Bonham, secretary-treasurer.

CINCINNATI

RECENT DEVELOPMENTS in architectural uses of concrete as a building material were covered at a recent meeting by C. C. Singleton, regional structural engineer for the Portland Cement Association at Philadelphia. The speaker used slides to show the many interesting textural effects obtained with concrete, and described its use in decorative moldings and precast panels. Mr. Singleton also discussed the new method of concrete construction in which walls are poured in a horizontal position and then hoisted into place, reducing the amount of time required for the work and the need for skilled labor for formwork.

CONNECTICUT

THE ARMY CORPS of Engineers offers many opportunities for a worth-while engineering career, Brig. Gen. Raymond G. Moses pointed out at a recent meeting held in Hartford. General Moses, who is division engineer for the New England Division of the Corps of Engineers, described the civil works of the Corps in that area. His talk was especially interesting to the members of the University of Connecticut Student Chapter who were guests of the Section for the occasion.

DISTRICT OF COLUMBIA

A COCKTAIL PARTY, substituted during the holiday season for a regular technical meeting, was much enjoyed. There was an attendance of 231 members of the Section and their families and guests.

FLORIDA

ENGINEERS SHOULD DO everything possible to foster the flood-control project currently contemplated for the central-southern portion of Florida, Col. A. G. Matthews, chief engineer of the Division of Water Surveys and Research for the State of Florida, told members of the Section at their January 8 meeting. In a talk on Florida's water-conservation program, Colonel Matthews stressed the potential asset of the project to the state. At the Section's recent annual meeting, certificates of life membership were presented to Alexander Blair, of Lake Placid, and Vernon G. Watters, of Sebring. A similar award will be made to Alexander Allaire, of Tampa, who was unable to be present. The technical program for the occasion consisted of a talk on American railroading by John Love Wilkes, president and general manager of the Jacksonville Terminal Co. Russell DeGrove is the new president of the Section, and Walter Parks, Jr., secretary-treasurer.

GEORGIA

IN THE FIVE-YEAR period from 1942 to 1947 the annual budget of the Georgia State Engineering Experiment Station at Atlanta increased from $35,000 to about $500,000, Dr. Gerald A. Rosselot, director of the Station, stated at a recent meeting. The speaker gave a brief account of the history of the Station, described the present plant, and showed slides to give the details of the laboratories and research projects. The Station, which works in cooperation with the academic and research staff of the Georgia School of Technology, has present contracts for nearly a million dollars worth of research.

MONTANA

THE FINANCIAL STATUS of the Society and efforts to balance the 1948 budget were outlined at a recent meeting by ASCE Director W. L. Malony, of Spokane. The speaker stressed the expanding professional interests and activities of the Society, pointing particularly to its participation in EJC affairs. In the general discussion that followed his talk, it was the consensus of the group that a proposal for raising dues without the subsidiary matter of changing the New York dues should be initiated at once and brought to vote as soon as possible. The Section's practice of sending out detailed meeting announcements in the form of news letters and of keeping the Director, Vice-President, and Society Field Representative informed of Section activities was commended by Mr. Malony.

DELEGATION FROM ASCE STUDENT CHAPTER at Montana State College meets with Society Director W. L. Malony at special dinner meeting of Montana Section in Helena.

ILLINOIS

PRESENTATION OF certificates of life membership to eight members of the Section featured the annual luncheon meeting. Recipients were John C. Black, Ralph Budd, Samuel A. Greeley, Floyd S. Hewes, Jacob L. Jacobs, Charles P. Richardson, Chester K. Smith, and Roe L. Stevens. New officers, elected during the meeting, are: George S. Salter, president; W. S. Lacher, vice-president; and Howard F. Peckworth, secretary. C. H. Mottier remains as vice-president for another year, and W. E. Busse as treasurer.

KANSAS

A TALK ON stream pollution in Kansas comprised the technical program at a recent dinner meeting. This was given by Ben L. Williamson, chief engineer of the Kansas State Board of Health. Part of the meeting was devoted to business discussion.

KANSAS CITY

WORK OF THE Junior Activities Committee of the Section in organizing the Juniors' highly successful technical programs during the past year was commended at the annual business meeting. A certificate of life membership in the Society was presented to H. L. Handley. Two other recipients—N. T. Veatch and J. H. Brooking—were unable to attend the meeting. The annual election of officers, held during this session, resulted in the choice of Ansel N. Mitchell for president; Josef Sorkin, first vice-president; J. Q. A. Greene, second vice-president; and Mark C. Culbreath, secretary-treasurer.

MIAMI

BULK BUYING AND obtaining of competitive prices would save the city of Miami many thousands of dollars each year, according to John Wilmot, executive of the Dade County Research Foundation, who addressed the January 5 meeting. Citing abuses and inefficiencies resulting from the fact that each city department does its own purchasing, Mr. Wilmot stressed the need for a central purchasing agency. There was some discussion of the feasibility of joining with the Professional Engineers Association of Southeast Florida to form a proposed joint engineering council.

MID-MISSOURI

ASCE DIRECTOR Harry F. Thomson attended the annual meeting at Columbia, which was a joint session with the University of Missouri Student Chapter. The technical program consisted of a talk on current Society affairs by Mr. Thomson and the presentation of four student papers. There was an attendance of 125.

LOUISIANA

A ROUND-TABLE DISCUSSION on how the Local Sections can improve their programs and increase their services to members was led by W. H. Scales, architectural engineer and Southern division manager for the National Lumber Manufacturers Association, at a recent meeting. Several committee reports were presented, and Roy T. Sessums, head of the civil engineering department at Louisiana Polytechnic Institute, discussed the "Career Days" held by the high schools in the northern part of the state. On these occasions the various faculty members of the Institute, which is located at Ruston, meet with groups of high school students interested in a particular career, to advise and guide them.

NORTH CAROLINA

NORTH CAROLINA'S rural-to-urban population switch has strained the water supplies of various municipalities, according to speakers at the Section's recent annual meeting in Greensboro. Engineers from various cities discussed water-supply problems they have encountered with the growth of their communities, and several described projects under way to meet the problem. John Spinks, Winston-Salem consultant, stated that his city must tap the Dan or Yadkin rivers for an adequate supply, and pointed out that the city has voted a $4,000,000 bond issue to improve its supply and avert a recurrence of last summer's shortage. Other speakers included ASCE Director William M. Piatt, of Durham, who discussed Society affairs. During the meeting certificates of life membership were presented to Robert M. Cooksey, of Thomasville; Thomas F. Hickerson, of Chapel Hill; and Carroll L. Mann, of Raleigh. Herman G. Baity was elected president of the Section for 1948; John D. Watson, first vice-president; and B. W. Davis, second vice-president.

NORTHWESTERN

ENGINEERING PROBLEMS encountered in the construction and maintenance of the Twin Cities sewage disposal plant were detailed at the January dinner meeting by Kerwin L. Mick, chief engineer of the Minneapolis-St. Paul Sanitary District, and John C. Sager, engineer of maintenance and design. Prof. George J. Schroepfer, former chief engineer of the Sanitary District, then commented briefly on the early history of the project. Other guests included George S. Salter, ASCE Mid-West Representative, who spoke on current Society activities.

OREGON

A SPECIAL DINNER meeting was recently held in honor of Leroy F. Harza, Julian Hinds, William H. McAlpine, and ASCE Past-President J. C. Stevens, all members of the Consulting Board to the Army Corps of Engineers, who met in Portland to discuss the design of the projected McNary and Lookout Point dams. The speaker of the evening was

ASCE Western Representative Walter E. Jessup, who discussed the EJC report, "The Engineering Profession in Transition."

PANAMA

A TALK ON future plans for the Panama Canal—given by Col. James H. Stratton, of the Special Engineering Division of the Panama Canal—comprised a recent meeting program. The principal speaker at another recent meeting was Dr. James Zetek, entomologist for the U.S. Department of Agriculture, who addressed the Section on the subject, "Termites, Teredos, and Their Relation to Engineering Structures." Section officers for 1948 are: J. P. Smith, president; Tomas Guardia, first vice-president; E. W. Zelnick, second vice-president; and N. E. Wise, secretary-treasurer.

PHILADELPHIA

CHARACTERISTICS OF THE relatively new technique of air entrainment were described by H. F. Gonnerman, manager of the research laboratory of the Portland Cement Association, Chicago, at the January 13 meeting. Although the technique is particularly applicable to road paving, where prevention of surface scaling is the prime objective, it is also being developed for structural use, according to the speaker. Among the advantages the method offers are ease of placement, minimizing of honeycombing, reduced water gain, and better appearance. The extensive research accomplished in this new field was illustrated by a comprehensive group of curves. At another meeting E. C. Gegenheimer, assistant general manager of the Eastern region of the Pennsylvania Railroad Co., presented a history of railroad transportation in the United States and discussed economic and engineering aspects of new types of motor power in rail transport.

SAN DIEGO

SPECIAL GUESTS AT the Section's annual meeting were ASCE Director John H. Gardiner, Director-elect Julian Hinds, and ASCE Western Representative Walter E. Jessup. Mr. Gardiner and Mr. Jessup spoke briefly on Society affairs, commenting particularly on the recent budgetary changes. The technical program for the occasion consisted of a talk by J. L. Burkholder on the 71-mile San Diego Aqueduct, which has just been completed. Mr. Burkholder, who is general manager and chief engineer of the San Diego County Water Authority, pointed out that the aqueduct is unique in having 21 vertical loops, each with different hydraulic gradients, and crests as open structures. New Section officers are: M. J. Shelton, president; R. S. Holmgren, vice-president; and J. F. Jorgensen, secretary-teasurer.

SEATTLE

TESTS ON CONCRETE culvert pipe recently performed at the University of Washington for the Washington State Highway Department were described at a recent meeting by William R. Mason, engineer for the Columbia Steel Co., Seattle. On the basis of these tests, Mr. Mason said, various changes have been made in the State Highway Department specifications for large concrete culvert pipes. Relationship between test and field conditions were then outlined by R. G. Hennes, associate professor of civil engineering at the University of Washington.

ST. LOUIS

ENGINEERS MUST BE aware of the overall implications of any engineering project with which they are connected, ASCE President E. M. Hastings told members of the Section at their annual dinner meeting. Mr. Hastings also pointed out that the engineer's analytical type of mind makes it possible for him to understand politics and economics, and urged the profession to take a more active part in national and international affairs. During the business meeting the following new officers were elected: William J. Hedley, president; Col. Malcolm Elliott, vice-president; Henry S. Miller, secretary-treasurer; and Walter A. Heinbuecher, councillor. The term of Walter R. Crecelius, senior vice-president, carries over for another year. Another feature of the meeting was the presentation of certificates of life membership to Wayne J. Burton, Morris C. Emanuel, and Robert C. White. The attendance of 168 included a number of students from the Missouri School of Mines and Washington University.

ASCE PRESIDENT E. M. HASTINGS addresses recent annual dinner meeting of St. Louis Section. Shown, in usual order, are: ASCE Director Harry F. Thomson; William J. Hedley, newly elected president of Section; Mr. Hastings; and John I. Parcel, retiring Section president.

FACULTY MEMBERS AND STUDENTS of Missouri School of Mines are photographed with ASCE President E. M. Hastings, guest of honor and principal speaker at annual dinner meeting of St. Louis Section.

TENNESSEE VALLEY

ALTHOUGH THE Holston Sub-Section is less than a year old, it handled the Section's two-day annual meeting, held at Johnson City, Tenn., in veteran style. Sub-Section President Dudley T. Parris—assisted by Secretary Sidney Smith, George Leonard, Oren Reed, and Jack McKamey—was in charge of local arrangements, and the over-all planning was handled by George Palo, program chairman for the Section. Principal speaker at the afternoon session was ASCE Executive Secretary William N. Carey, who outlined recent Society activities, commenting particularly on ASCE participation in EJC affairs and on the present financial situation. A talk on the Watauga Dam project, by George K. Leonard, project manager for the TVA, concluded the afternoon session. Speakers at the Friday evening dinner dance were ASCE Vice-President Gail A. Hathaway, Eastern Representative Lawrence E. Chandler, and Col. E. W. Palmer, president of the Kingsport Press. Saturday morning was devoted to inspection of the Watauga Dam construction site and to witnessing a huge blast of rock for the project. The estimated volume of rock in the blast was 335,700 cu yd, making it the largest ever to be set off. The charge of 520,000 lb of Nitramon was placed in 2,600 lin ft of coyote hole tunnels. William N. Calvert, Knoxville, was elected president of the Section for 1948. Sub-Section presidents, elected at the annual meeting, are shown and named in the accompanying photograph. Sub-Section secretaries are: Clyde A. Needham, Knoxville; Jack M. Terry, Chattanooga; Melvin C. Thomas, Holston; and W. Douglas Lavers, Oak Ridge.

MBERS OF BOARD OF DIRECTION of Tennessee Valley Section are photographed at ent organizational meeting. Shown, left to right, are: Lewis A. Schmidt, 1947 president; rren A. Niles, president of Oak Ridge Sub-Section; Leonard C. Bailey, president of Knoxle Sub-Section; Ernest M. Titus, Section secretary-treasurer W. N. Calvert, Jr., 1948 tion president; Raymond L. Moore, president of Chattanooga Sub-Section; Albert B. odwin, president of Asheville Sub-Section; and Sidney N. Smith, president of Holston b-Section.

SYRACUSE

THE ARMY'S COOPERATIVE program for training specialized technical units required for efficient operations in national defense was outlined by Maj. John F. Hansell, of the Army Corps of Engineers, at a joint dinner meeting with the Syracuse University Student Chapter. Speaking on the subject, "War Department Affiliated Units Program," Major Hansell emphasized the importance of the program to national defense. ASCE Director Harland C. Woods, of Buffalo, was a guest of the Section for the occasion.

VIRGINIA

MEETING WITH THE Engineers Club of the Virginia Peninsula at Newport News, Va., to discuss the organization of an engineers joint committee in the area, members of the Virginia Section heard ASCE Eastern Representative E. Lawrence Chandler report on EJC activities on the local, national, and international level. In Mr. Chandler's address, entitled "Putting Your Shoulder to the Wheel," he indicated the constructive efforts that should be made to advance EJC and promote closer cooperation among the various branches of the profession. Following his talk, P. A. Rice, Virginia chairman for EJC, reported on local progress to date, as did the other Founder Society representatives on the state EJC committee. W. C. Roberts was chairman of the Section committee on arrangements for the meeting, which was attended by 175.

STUDENT CHAPTER *Notes*

LINOIS INSTITUTE OF TECHNOLOGY

TECHNICAL ABILITY IS not enough, CE Mid-Western Representative orge S. Salter told Chapter members at ecent meeting. Mr. Salter stressed the portance of social contacts and of such racurricular activities as serving on mmittees for engineering students intered in getting jobs. He also pointed the need for better education in ecomics, sociology, and management subts. At another of the Chapter's biekly meetings Leonard P. Zick, Junior ntact Member for the Chapter, also cussed the necessity of associating with e's fellow engineers. Movies on engiering subjects have been much enjoyed other sessions, and the showing of a chnicolor film on the civil engineers' summer camp featured the annual smoker. Chapter officers for the school year are: James H. Old, president; Frank Nelson, vice-president; John J. Vetter, secretary; and Howard Baum, treasurer.

CLARKSON COLLEGE OF TECHNOLOGY

PROF. EMIL A. GRAMSTORFF, head of the civil engineering department at Northeastern University, Boston, and member of the ASCE Committee on Student Chapters, addressed a recent banquet. Other guests included Dr. John P. Brooks, president emeritus of Clarkson College; Jess H. Davis, acting president; William J. Farrisee, dean of men; and William T. Field, Student Chapter Contact Member. Officers of the Chapter are: Robert D. Hilliard, president; Frederick A. Rexford, vice-president; Louis G. Petro, secretary; and Howard E. Lechler, treasurer.

PURDUE UNIVERSITY

MORE THAN 150 new members for the Purdue Student Chapter were obtained as a result of a membership drive. ASCE Vice-President Ralph B. Wiley addressed a recent meeting on the advantages of Student Chapter membership and of early affiliation with the Society. Another recent speaker was Prof. K. B. Woods, director of the Joint Highway Research Project at Purdue, who gave an illustrated lecture on the perma-frost investigations made in Alaska during the past summer under his direction. Present Chapter officers are: Leon Abele, president; Robert Esch, vice-president; Philip Neff, secretary; and James Zervas, treasurer.

UNIVERSITY OF WYOMING

METEOROLOGY IN ITS application to engineering was discussed at a recent meeting of the University of Wyoming Chapter by Jac Logan, of Laramie, former member of the Army Air Force. The Chapter reports that it is currently engaged in a membership drive with very good results. The present enrolment is about 75. Chapter members have been working on a new constitution.

NEWS BRIEFS

PRA Reports Faster Pace Set in 1947 Highway Improvement

IMPROVEMENT of the nation's highways proceeded at a faster pace in 1947 than in the preceding year, according to reports received from state highway departments by the Public Roads Administration of the Federal Works Agency. Reviewing the progress of the highway program, Public Roads Commissioner Thomas H. MacDonald, Hon. M. ASCE, said contract awards authorized by the states during the year called for $895,000,000 worth of work on 44,700 miles of road. This sum was approximately $150,000,000 more than the cost of road construction contracted for in 1946. The 1947 total included contracts for federal-aid projects for 19,800 miles of highways at a cost of $640,000,000. Expenditures for state-administered highway work under way during the year amounted to approximately $890,000,000.

At the year's end, Commissioner MacDonald said, federal-aid projects costing more than $700,000,000 were under construction, and plans had been approved for additional projects costing around $350,000,000, on which work is expected to start this year.

The total estimated cost of federal-aid projects programmed by the states for construction but not yet advanced beyond the planning stage was nearing $750,000,000, commissioner MacDonald stated.

The urgent need for better highways throughout the nation was emphasized by steadily mounting floods of traffic on main rural roads and urban thoroughfares. Motor vehicle registrations in 1947 are estimated to have exceeded 37,000,000, setting an all-time record. This was approximately 3,200,000 more than the 1946 total and 2,644,000 above the number of motor vehicles registered in 1941, the previous peak year. The increasing use of highways for commercial transportation was reflected in the fact that truck registrations rose from 4,859,244 in 1941 to an estimated total of 6,500,000 in 1947, an increase of around 33.7 percent. The increase over the 1946 total of 5,725,692 registrations was about 13.5 percent.

With traffic congestion steadily becoming more serious, one of the most important developments in 1947 from the standpoint of the average motorist was the designation of a 40,000-mile interstate system of highways which eventually will be improved to high standards, Mr. MacDonald said. The system includes routes carrying large volumes of traffic into and through cities (CIVIL ENGINEERING, September, page 55).

Multiple-Purpose Project Is Recommended in Army Report

CONSTRUCTION OF a new dam and powerhouse at Albeni Falls on the Pend Oreille River, Idaho, some 5 miles downstream from its confluence with Priest River, is recommended in a recent report of the Army district and division engineers for the Seattle District, North Pacific Division of the Corps of Engineers.

The report recommends that the Albeni Falls project, consisting of a dam and reservoir to normal elevation 2062.5 ft be adopted at an estimated cost to the United States of approximately $27,000,000 for construction and $100,000 annually for operation and maintenance, both estimates based on 1947 prices. It also recommends that provision be made for future recreation, conservation and public health facilities as may be determined by the Secretary of the Army to be desirable and economically justifiable.

The project will add 251,000 kw of urgently needed firm capability to the regional system of existing and authorized power projects through the use of the stored water in three 14,200-kw units proposed at Albeni Falls and in downstream plants in existence or already authorized by Congress. Increased channel depths during low-water periods in navigable reaches of the Columbia River will result from the new construction.

Aluminum Production Tops Previous Peacetime Records

ON THE BASIS of preliminary figures published by the U.S. Bureau of Mines for the first nine months of 1947, actual production of primary aluminum by the whole U.S. industry during the year is estimated at approximately 1,140,000,000 lb, as compared with 819,260,000 lb in 1946—the greatest previous peacetime-year record—for an increase of more than 39 percent. Thus, according to Roy A. Hunt, president of the Aluminum Co. of America, it appears certain that aluminum will more than maintain its leadership as the first-ranking nonferrous metal of industry from the standpoint of volume produced.

Despite the production records set in 1947, the aluminum supply situation tightened toward the end of the year, particularly in certain mill products such as sheet. Demand for these mill products, over and above what would otherwise be the ca[pacity] has been chiefly caused by shortages of oth[er] materials such as steel and galvanized [sheet]. Although prices for most other materi[als] have increased sharply, the basic price [of] aluminum has decreased a full 30 perc[ent] since 1939, Mr. Hunt revealed.

Public Works Contracts Show Marked Increase

CONTRACT AWARDS for state and lo[cal] construction increased 35 percent dur[ing] the first nine months of 1947, total[ing] $1,591,000,000 as compared with $1,17[8],000,000 during the same period in 1946, a[c]cording to an announcement of the Fede[ral] Works Agency. At the time of expirati[on] of the federal-aid law last year, New Yo[rk] led all other states with a backlog of spec[ial] public works proposals totaling $3,743,0[00],000. Of this total, plans were complet[ed] for projects valued at $416,000,000. Cal[i]fornia followed with a proposed work pr[o]gram estimated at $1,941,000,000.

Of contracts actually awarded, New Yo[rk] State also led with a total of $154,000,[000] and California was again second wi[th] $134,000,000. Pennsylvania followed wi[th] $120,000,000; Texas, $102,000,000; Il[li]nois, $91,000,000; Ohio, $63,000,000 a[nd] Michigan, $59,000,000. All sections of th[e] country except New England showed a d[e]cided advance over 1946, the Pacific State[s] increasing by 66 percent and the Sou[th] Atlantic States by 60 percent. New Eng[land]'s contracts declined by 11 percent.

Industrial Building Decline May Offset Construction Ris[e]

RESIDENTIAL CONSTRUCTION, with a valu[e] of around $6 billion as against $4.8 billion [in] 1947, is expected to be the largest single ite[m] in the 1948 privately financed building pr[o]gram, estimated jointly by the Department [of] Commerce and Labor at more than $11 [b]illion, about 75 percent of the total cost [of] $15.2 billion for all new construction. Fur[ther] building expeditures will be around $3[00] million or a little more than 10 percent abov[e] those of 1947, the same sources indicate.

In the private non-residential field, ac[cording] to these government departments, an estimated increase of $430 million in ge[n]eral commercial building may be offset in 1948 by a decrease of some $340 million [in] industrial construction.

Highway construction may again be [the] largest item in publicly financed projects wi[th] an expenditure of $1.5 billion—almost [40] percent of the total public works' outla[y] estimated at $3.8 billion. Non-residential public construction is to cost around $8[00] million, an increase of more than 60 perce[nt] above the 1947 outlay.

Radar's "Magic Eye" Surveys a Continent

SURVEY BY RADAR of Australia's 3,000,000 square miles of territory is now being undertaken in reorganizing the mapping of that continent under its National Mapping Council. Consisting of the commonwealth's Surveyor-General, an army representative and the surveyors-general of the commonwealth's six states, the Council has assigned the task to the Australian Army Survey Corps and the Royal Australian Air Force survey unit. The continent will be systematically mapped for settlement, regional planning, highways, railways, water supply, mining, forestry, agriculture and irrigation, and all defense service needs will be coordinated.

Officers from the Australian army and air force are in England studying recent advances in radar map technique, developed largely in Southeast Asia during the war, while a special committee of physicists attached to the Council for Scientific and Industrial Research is engaged in research to perfect Australian equipment and investigate factors in radar use peculiar to Australia. Settled areas will be mapped on a scale of one mile to the inch and the hinterland at four miles to the inch.

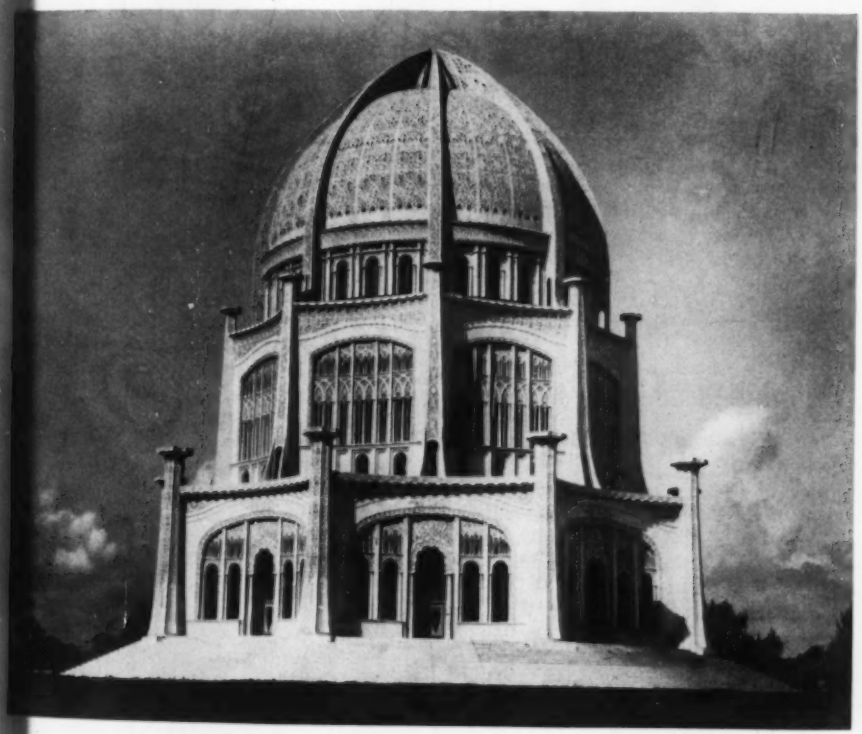
Colonized less than 160 years ago, Australia is largely unmapped in the technical sense. Maps of one kind or another cover the whole continent—some of 8 miles to the inch—but many are based on old and questionable data. Only part of the country, embracing a relatively narrow coastal strip, running roughly from Adelaide through Melbourne and Sydney to Brisbane, has been covered by first-class surveys.

Areas to be charted include the lonely barren center of the continent, the remote north and northwest, and the jungle-clad fastnesses of the Australian mandated islands where field parties would be costly and difficult to maintain. Equipped for a protracted stay, the scientific expedition arriving in the Antarctic toward the end of 1947 will also use radar technique in exploring and mapping the icebound wastes of Australia's possessions in that region.

Adaptation to surveys of radar's "magic eye" is revolutionizing the mapping of great expanses of country, making possible immediate measurement of long distances over which radar waves speed at a rate of 200,000 miles per second, compared to months required to cover such distances in difficult terrain by ordinary survey. With the survey party 150 miles away, camera location is determined by remote control at the moment of exposure within an accuracy of 20 yd. Camera tilt effect on the photograph is measured by photogrammetric equipment and all points of detail are transferred to the conventional map in their true positions.

By these modern methods a complete and accurate map of the Australian continent is possible within the next 20 years.

Structure Features Ornamental Use of Concrete



CONCRETE PROVES ITS ORNAMENTAL as well as structural worth in intricate design treatment that dominates architectural motif of Baha'i Temple, Chicago area landmark. Structure consists of four stories of concrete and steel, covered with ornamental shell. Hundreds of decorative units are cast individually from molds poured with mixture of white portland cement and crushed quartz and joined together to form unbroken surface of outer shell. Resulting ornamental concrete has hardness and endurance of natural stone. Design for ornamentation and finishing of interior of temple will begin in few months on schedule calling for completion in 1953. Preliminary estimates fix cost of interior ornamentation at $300,000 bringing total cost of land and structure to more than $2,000,000. Nearly $1,500,000 has already been expended since construction began in 1920.

Applied Mechanics Congress Meets Next Year in London

AMERICAN ENGINEERS and scientists are invited to attend the Seventh International Congress of Applied Mechanics to be held at the Imperial College of Science and Technology, South Kensington, London, England, September 5–11, 1948.

Technical sessions will be organized under the following sections: (1) elasticity and plasticity; (2) aerodynamics, hydrodynamics, meteorology; (3) thermodynamics, heat transfer, etc.; and (4) vibrations, lubrication, and experimental methods. In addition, as many as ten general lectures or surveys are contemplated on subjects likely to be of interest to members.

Members whose papers are accepted for presentation should provide copies of abstracts for the information of other members. These should be in the hands of the organizing secretary of the Congress as early as possible. The Imperial College has no facilities for reproduction of abstracts of papers.

A registration fee of approximately $5 may be paid at the time of registration or in advance to the organizing secretary at Imperial College. Engineers planning to attend the Congress should contact the Organizing Committee at an early date.

Study of Apprentice Needs in Skilled Trades Is Urged

PREPARATION OF an up-to-date census of the number and distribution of skilled workers in the country, and determination of the number of trained apprentices needed in every community for the steady supply of the skilled trades, were emphasized as industry's greatest responsibilities by William F. Patterson, director, Apprentice-Training Service of the U.S. Department of Labor, in an address at the recent graduation ceremonies sponsored by the Connecticut State Apprenticeship Council.

Pointing out that such a census has not been taken since 1940, and that few apprentices were trained in industrial expansion during the war, Mr. Patterson urged that in every area local management-labor committees or employer organizations and unions ascertain the exact number and age of skilled workers, number of workers needed and number of apprentices in training required for each trade. An analysis should be made each year, he said, to keep the ranks of apprentices filled without being overmanned or undermanned.

Comprehensive Report Recommends Two New San Francisco Bay Crossings

TWO ADDITIONAL San Francisco Bay crossings are needed as essential links in California's highway system, according to the report of Director of Public Works C. H. Purcell, M. ASCE, submitted to the California Toll Bridge Authority following a comprehensive two-year study. This recommendation has been concurred in by the Authority with the emphatic support of its chairman, Governor Earl Warren, according to a recent issue of *California Highways and Public Works*.

The two recommended crossings, selected from 12 included in the study, are estimated to cost $239,468,000, the report states. One crossing—a toll bridge estimated to cost $105,000,000—would run from Rincon Hill in San Francisco to Oakland via Yerba Buena Island, north of and approximately parallel to the existing San Francisco–Oakland Bay Bridge, with a tube under the Oakland Estuary, giving access to the East Bayshore Freeway and the City of Alameda. The other recommended route would be a toll highway—estimated to cost $134,468,000—crossing the bay to the south from the Bayshore Freeway near Army Street, San Francisco, to the southern limits of Alameda, continuing northward across the Oakland Estuary to a connection with the East Bayshore Freeway in Oakland.

The Department of Public Works will continue its activities to determine the essential facts with relation to both crossings. When these factors are determined, and before deciding the priority of construction, the California Toll Bridge Authority will hold public hearings at which interested persons and public agencies will be invited to testify.

Road Builders Discuss Current Highway Problems

HIGHWAY CONSTRUCTION in 1948, pending highway legislation, the effect of the Marshall Plan on the road-building industry, and many subjects pertaining to postwar highway and airport development, were discussed at the annual meeting of the American Road Builders Association, held recently in Washington, D.C.

Among those addressing the three-day conference were Maj. Gen. Philip B. Fleming, M. ASCE, Federal Works Administrator; Thomas H. MacDonald, Hon. M. ASCE, Commissioner, Public Roads Administration; and Charles M. Upham, M. ASCE, engineer-director, American Road Builders Association.

Other ASCE members who gave talks on various phases of highway and airport construction at the technical sessions were: Robert B. Brooks, Claude L. McKesson, Leslie Williams, Raleigh W. Gamble, Brig. Gen. Gordon R. Young, Miles D. Catton, Frank A. Nikirk, E. C. Crites, John B. Ecker, Harold F. Clemmer, John Nolen, Jr., Fred W. Tuemmler, B. E. Beavin, and Ray Cavendish. Dean S. S. Steinberg, of the University of Maryland, presided at a meeting of the Planning Division.

A meeting of the officers and executive committee of the National Association of State Aviation Officials was held in conjunction with a meeting of the Airport Division, with Maj. Gen. Julian L. Schley, M. ASCE, presiding.

Steels and Welds Are Tested in High-Speed "White Pit"

HIGH-SPEED ROTATION of steel disks inclosed in an armored "whirl pit" is now being used to test steels and welds at extreme temperatures while providing biaxial stress in the test piece all the way to fracture. Basic research on this and other engineering problems is now in progress at the Massachusetts Institute of Technology with funds allocated by the Engineering Foundation. Results will be particularly useful to bridge engineers, shipbuilders, Army and Navy engineers and others interested in the use of steel at extremely low winter temperatures.

In whirl-pit tests, disks, 26-in. in diameter and up to 8 in. thick, are suspended from a flexible steel drive shaft and rotated up to 35,000 rpm in a 30-in. vacuum which prevents heat generation and permits stoppage of rotation at any moment by admission of air.

Composed of three sheets of Class B heavy armor plate, the whirl pit, 40 in. in diameter and 9 ft deep, is lined with lead pigs to preserve the disks for observation and measurement after fracture. As the disk rotates at high speed, the material actually flows toward the edges and thickens the disks at the perimeter. Future tests will provide interesting information on plastic flow and strains. For welding tests a small central disk is welded within the outer disk.

Washington Makes Plans to End Congested Areas

PREPARATION OF A MASTER PLAN for future development of the national capital is now in progress under the Urban Redevelopment Act of 1946, implemented in 1947 by a federal grant of $75,000. Under terms of the act the National Capital Park and Planning Commission, created by Congress in 1926, is authorized to have prepared a comprehensive master development plan as the basis for a future $20,000,000 improvement scheme to rid the city of Washington of its blighted sections in congested downtown areas. Under the act such a plan must be drawn and approved before any specific projects may be undertaken.

Toward this end the commission has selected Harland Bartholomew, M. ASCE, city planning expert of St. Louis, Mo., to prepare a plan which will embody much of the groundwork already laid in studies made since publication of the commission's last annual report, issued 14 years ago. Mr. Bartholomew was consultant to the District Commissioners in preparing the zoning map under the act of 1920 and has acted in an advisory capacity to the Planning Commission since its inception in 192[illegible].

Waterways Experiment Station Needs Qualified Engineers

QUALIFIED hydraulic, soil mechanics, mechanical, electrical and concrete research engineers to assist in the accomplishment of a greatly expanded research and investigational program are needed immediately by the Waterways Experiment Station, Vicksburg, Miss., according to its director, Lt. Col. R. D. King.

Work in the hydraulics laboratory of the Experiment Station is devoted to practical problems in river and harbor and flood control engineering. Extensive experimentation is conducted on the design of hydraulic structures, such as spillways and stilling basins of major dams, and on works required for maintenance of depths or alignment of navigable channels.

The soil mechanics laboratory is concerned with routine testing to determine the strength and behavior of soils under different conditions which may be imposed and is engaged in original research and the development of soil-testing methods, equipment and techniques. A special branch of the soil mechanics laboratory is engaged in the design of flexible pavements for airports.

The concrete research laboratory is engaged in conducting all major research activities required by the Corps of Engineers pertaining to the basic improvement of concrete structures to be built by the Corps of Engineers.

A fourth technical division at the Experiment Station, the Research Center, serves as a technical information center for the Corps of Engineers and is responsible for reports and publications on research investigations.

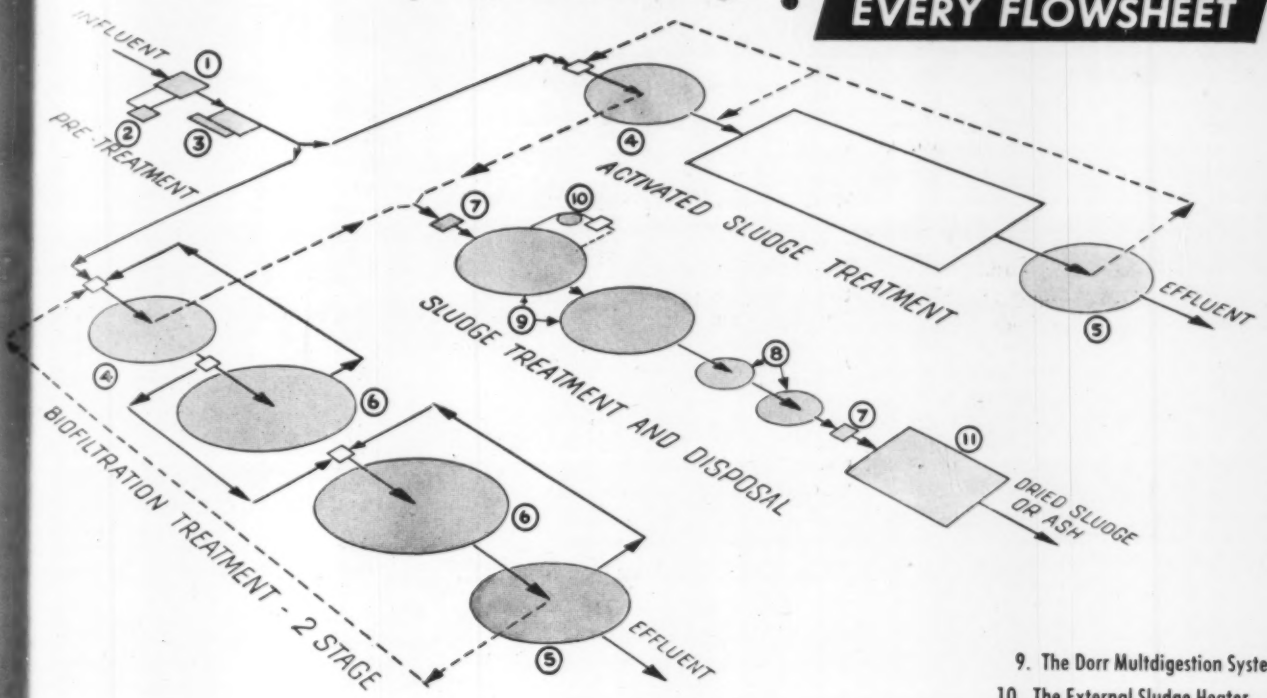
Colonel King states that the Experiment Station offers exceptionally attractive possibilities to professional personnel with opportunities for rapid advancement. Those interested in the work outlined here can submit Applications for Federal Employment (Form 57, which may be obtained from any local post office) to the Director, Waterways Experiment Station, Corps of Engineers, P.O. Box 631, Vicksburg, Miss.

Chicago Professionals to Have Technical, Scientific Center

CREATION OF a Chicago technical and scientific center for the use of professional persons, students and others interested in the advancement of science has been effected through an agreement between the Western Society of Engineers and the John Crerar Library. The society's action in leasing three floors in the library-owned Taylor Building provides the newly created center with offices, conference rooms and an auditorium seating 300—a total of 9,000 sq ft of floor space. Eventually, other professional groups are expected to participate with the Western Society of Engineers in the program of the center.

in sewage treatment . . .

THERE'S A DORR UNIT *for practically* EVERY STEP IN EVERY FLOWSHEET



Regardless of type of treatment or size of plant, there's a Dorr unit for practically every step in every basic sewage treatment flowsheet. The composite drawing above illustrates the extent to which the completely integrated Dorr line of equipment can be utilized to solve sewage treatment problems.

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For Primary Treatment
* The Dorrco Flocculator
4. The Dorr Clarifier
or
* The Dorrco Monorake

For Secondary Treatment
5. The Dorr Clarifier
or
* The Dorrco Monorake
6. The Dorrco Distributor

For Sludge Disposal and Treatment
7. The Dorrco Sludge Pump
8. The Dorr Thickener
* The Dorr Digester
9. The Dorr Multdigestion System
10. The External Sludge Heater
11. The C-E Raymond System (sludge drying/incineration)

For Combination Treatment
* The Dorr Duo-Clarifier (primary and secondary clarification)
* The Dorrco Duo-Filter (primary and secondary filtration)
* The Dorrco Clariflocculator (flocculation and clarification)
* The Dorr Clarigester (clarification and digestion)
* The Currie Claraetor (aeration and clarification)
* The Dorrco Vacuator (for grit, scum and solids removal)

*Alternative or combination units not shown on composite drawing.

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RESEARCH ENGINEERING EQUIPMENT

Western Construction Projects Announced by Bureau of Reclamation

LARGE CONSTRUCTION projects in Western states are listed in the Bureau of Reclamation's *Advance Construction Bulletin* for January 2 as "Bid Calls Expected This Month." These bid calls are "for information only and subject to revision," the *Bulletin* states. The data given will, however, provide an indication as to the nature, size and location of proposed reclamation projects.

MISCELLANEOUS CONSTRUCTION

Columbia Basin Project, Washington

Location: Vicinity of Grand Coulee Dam.
Work: Production of concrete aggregate; completion of right powerplant control building, right powerplant control cable tunnel, and right powerplant parking area; placing of miscellaneous architectural finishes in powerhouse, service and control bays of right powerplant; construction of right switchyard; construction of transformer circuits and tie circuits between right and left switchyards; construction of transformer platform for substation for maintenance of spillway bucket.

Excavation (all classes)	220,000 cu yd
Preparation of aggregate	280,000 tons
Furnishing reinforcing bars	700,000 lb
Placing reinforcing bars	2,500,000 lb
Concrete	28,000 cu yd
Erection of steel structures for transformer and tie circuits	670,000 lb
Furnishing and installing steel and wrought-iron pipe	62,500 lb
Furnishing and installing cast-iron bell-and-spigot pipe	175,000 lb
Installation of electrical conduits	49,000 lin ft
Erection of steel structures for right switchyard	1,300,000 lb

Time Allowed for Completion: 500 days

CANAL

Central Valley Project, California

Location: Near Visalia, Calif.
Work: Construction of earthwork, lining, and structures of approximately 14.5 miles of Friant-Kern canal.

Excavation	2,803,000 cu yd
Concrete	97,000 cu yd

Time Allowed for Completion: 700 days

TUNNEL AND CANAL

Riverton Project, Wyoming

Location: At confluence of the Wind and Big Horn rivers near Pavillion, Wyo.
Work: Construction of Muddy Ridge Tunnel, approximately 2,870 ft long; about 2,000 ft of Wyoming Canal and extensions; about 2,000 ft of lateral.

Excavation	113,900 cu yd
Concrete	3,400 cu yd
Furnishing and placing steel tunnel supports	190,000 lb
Furnishing and placing reinforcement steel	188,000 lb
Timber lagging	113 Mb. m

Time Allowed for Completion: 600 days

WASTEWAYS

All-American Canal Project, California

Location: Vicinity of Indio and Coachella, Calif.
Work: Construction of earthwork and structures, and lining Wasteways 2 and 3 for flood protective works.

Excavation, channels	371,000 cu yd
Excavation, structures	24,600 cu yd
Concrete, channels	9,200 cu yd
Concrete, structures	1,830 cu yd

Time Allowed for Completion: 360 days

PENSTOCKS

Davis Dam Project, Arizona-Nevada

Location: 30 miles west of Kingman, Ariz.
Work: Fabrication of five 22-ft-dia welded, plate steel penstocks.
Time Allowed for Completion: 500 days

CANAL

Central Valley Project, California

Location: Near Tracy, Calif.
Work: Construction of earthwork, lining, and structures for 13.6 miles of Delta-Mendota Canal.

Excavation	6,000,000 cu
Concrete	102,700 cu
Furnishing and placing reinforcement steel	2,667,000 lb
Furnishing and installing 15- to 30-in.-dia concrete pipe	3,300 lin ft

Time Allowed for Completion: 750 days

PUMPING PLANT

Klamath Project, Oregon-California

Location: Near Merrill, Ore.
Work: Construction of Adams 60-cfs pumping plant with wooden superstructure.

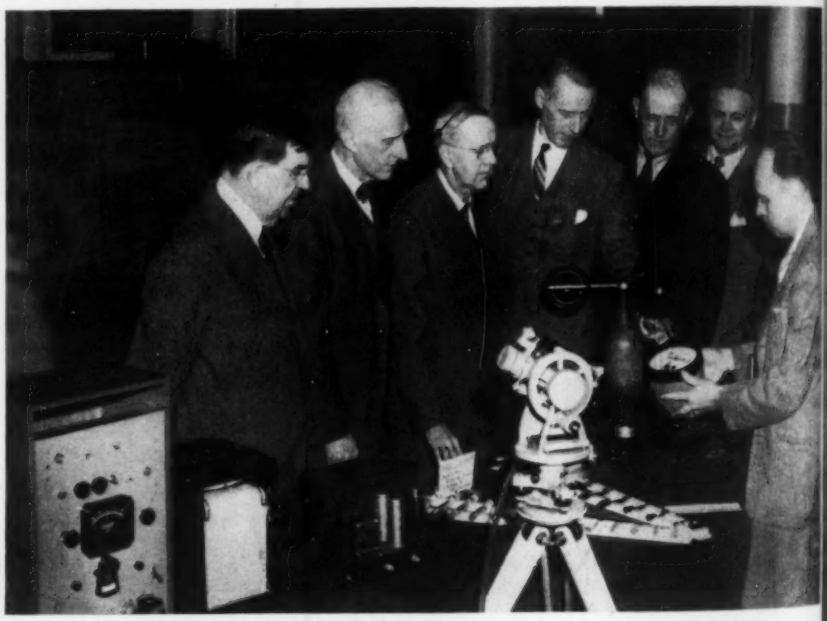
Furnishing and placing reinforcement steel	52,000 lb
Miscellaneous metal work	3,000 lb
Installation of pumping units	18,000 lb
Excavation	3,300 cu
Furnishing and placing trashrack structures	9,000 lb

Time Allowed for Completion: 180 days

Admiral Hussey Appointed New ASA Administrative Head

APPOINTMENT of Vice-Admiral George F. Hussey, Jr., U.S.N. (Ret), to succeed Dr. P. G. Agnew as administrative head of the American Standards Association has been announced by ASA's Board of Directors. Admiral Hussey, who was wartime chief of the Navy's Bureau of Ordnance, took office January 1, 1948.

Instrument Exhibit Shows 100-Year Progress



PRECISION INSTRUMENT EXHIBIT displays century of progress in evolution of fine surveying and engineering instruments—from 110-year-old hoop-sight compass, explorer's transit dating back to 1867 and 80-year-old builder's level to first modern all-aluminum transit. W. & L. E. Gurley, Troy, N.Y., revive practice observed in early days of company's 102-year history of stimulating family interest in employee's work by staging novel 3-day "See-Us-At-Work" tour, extended also to general public. Charles I. Day, Assoc. M. ASCE, president (at left), and staff members examine new Gurley glass reticles. Items of company's products here on view include magnetometer assembly, engineer's transit, level vials and electronic anemometer transmitter.

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BUILT STRONGER TO LAST LONGER

New all through!

NEW ENGINES! Brand new Six, two new V-8's . . . up to 145 h.p.

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Bonus* Built —THE AMAZING RESULT OF AN ENGINEERING PRINCIPLE THAT ASSURES LONGER TRUCK LIFE . . . and ONLY Ford Trucks Have It!

The great new Ford Trucks for '48 are revolutionary not only because they are *new all through* but because they are the amazing result of a time-proved truck engineering principle. This principle is Ford Bonus Built construction.

Bonus Built = Extra Strength! Every single one of the great new Ford Trucks for '48 is Bonus Built . . . designed and built with a margin of *extra strength* in every vital part. But that is only *part* of this vital truck building principle . . .

Bonus Built = Work Reserves! This *extra strength* provides WORK RESERVES that pay off for truck operators in two important, money-saving ways . . .

Bonus Built = Greater Range of Use! These Bonus Built WORK RESERVES give Ford Trucks a *greater range of use* by permitting them to handle loads beyond the normal call of duty! That means that Ford Trucks are *not* limited to doing only one single, one specific job!

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See the great new line of Ford Bonus Built Trucks for '48 now!

***BONUS:** "Something given in addition to what is usual or strictly due."— Webster's Dictionary*

LIFE INSURANCE EXPERTS PROVE . . . FORD TRUCKS LAST UP TO 19.6% LONGER!

Texts of Refresher Courses for State Examinations Available

AIDS TO ENGINEERS in reviewing subjects covered in state examinations for professional licenses have been prepared by various agencies. One such aid recently called to the attention of ASCE Headquarters is a 170-page mimeographed book by August E. Waegemann, Jun. ASCE. The book, entitled *California Civil Engineer Examinations and Solutions*, consists of 15 examinations, given between 1940 and 1947 inclusive together with their solutions. Copies may be purchased at $3.50 each from Mr. Waegemann at 2833 Webster Street, San Francisco 23, Calif. Another book used by engineers in preparation for state professional examinations in California is entitled *Fundamentals of Civil Engineering*. Prepared by John K. Minasian, Jun. ASCE, this sells for $3 and may be obtained from him at 531½ West 48th Street, Los Angeles 37, Calif.

Texts of interest to civil engineers used in refresher courses, given under the auspices of the New York Metropolitan Sections of the ASME and the AIEE, include:

Notes on Hydraulics and Thermodynamics, by John D. Constance, 506 Olympia Avenue Cliffside Park 7, N.J.; $3. (Similar notes on Machine Design and Electrical Fundamentals are in preparation.)

Review of Structural Design, by S. W. Spielvogel, M. ASCE, 15 Old Field Lane, Lake Success, N.Y.; $4.

Structural Planning and Design, by William Glendinning, 5123 Bell Boulevard, Bayside, N.Y.; $3.

Engineering Economics and Practice, by M. J. Steinberg and William Glendinning, 5123 Bell Boulevard, Bayside, N.Y.; $3.

Leaflets giving details of the refresher courses offered jointly by the ASME and the AIEE are issued in the middle of January and August each year. Copies may be obtained from the Headquarters of the ASCE, ASME, or AIEE, 29–33 West 39th Street, New York 18, N.Y. Another refresher course is given under the auspices of the Cooper Union Alumni Association, 313 West 53d Street, New York 19, N.Y. Applications should be filed well in advance for the latter course, as enrolment is limited.

Lowest Traffic Death Rate on Record Is Indicated for 1947

TRAFFIC FATALITIES for the year 1947 are estimated by the National Safety Council at 32,500, a total which is 1,200 less than the figure for 1946 and 7,469 less than the record high of 39,969 fatalities in 1941. Although travel figures are not yet available for the entire year, the Council estimates that mileage in 1947 ran about 10 percent above 1946 and about 12 percent above 1941. This would mean a 1947 fatality rate (deaths per 100 million vehicle miles) of between 8.5 and 9—a record low.

Publications and materials on highway safety and related matters of design, construction and traffic facilitation are listed in a bibliography prepared at the request of the National Committee for Traffic Safety and printed for distribution by the Highway Research Board.

R. Robinson Rowe, M. ASCE

IT'S NOT UNUSUAL during dinner at the Engineers Club for the boys to hold a fork in one hand and a pocket slipstick in the other to prove some pertinent point on the performance of pumps. Mrs. Grundy would have disapproved, but tonite she'd have loosed her tongue in earnest—the boys were tearing and folding their paper napkins and measuring the folds with crackers.

"I've got it!" yelled Joe Kerr. "You have to tear off one-tenth of the napkin, then fold a lower corner to the top edge and the areas

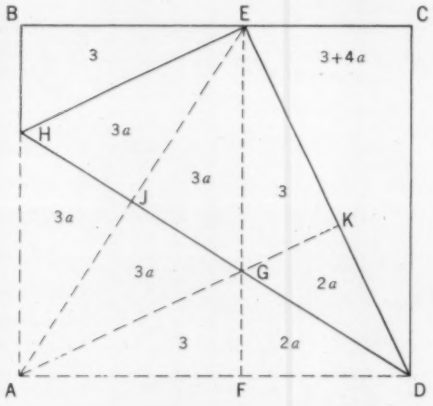


Fig. 1. An engineer folds his napkin

of the 3 triangles will be in the proportion 1:2.5:4. So the largest triangle will have an area of 12."

"Mighty close," conceded Cal Klater, "but it's quicker to use geometry—if you know how. In Fig. 1, rectangle ABCD has been folded into the trapezoid BCDH so that, in area, CDE is a mean between BEH and EDH. The area of BEH is given as 3 and, to avoid fractions, we can let the others be CDE = 3 + 4a and EDH = 3 + 8a. Now draw EF⊥AD, AK thru the intersection G, and rhomb diagonal AE, so that we have 10 triangles which can be expressed in terms of a.

"Obviously CDE is similar to BEH and JDE to JEH, and in each case the scale ratio is DE:EH. Therefore the areas are proportional, that is:

$$3 + 4a:3 = 3 + 5a:3a$$

which reduces to

$$4a^2 - 2a = 3$$

$$4a = 1 + \sqrt{13}$$

$$A = 3 + 8a = 5 + 2\sqrt{13} = 12.2111 \text{ in}^2.$$"

"Very efficient, Cal. I was glad to see that you didn't fool around solving for the size of the card."

"Well, actually I did, Professor Neare. My first hunch was that the problem should be set up in integers, as usual, but I found the dimensions rather complicated."

"But if set up in integers, Cal, it would have been too easy, as you can see by finding a 100×96 card. All integral cards can be generated by the dimensions $2mn(m^2+n^2)^2$ and $8m^2n^2(m^2-n^2)$, where m and n are any integers. Since you like integers, you might be interested in some statistics which I developed while sending out New Year cards because I hadn't sent Xmas cards.

"In Esseyeville alone, the postage on holiday greeting cards was about $200. On the average, each citizen knew 1 person of his fellow citizens, 29 percent of the citizens sent Xmas cards to 10 percent of their acquaintances and the other 71 percent sent "answer" New Year cards to 7 percent of their acquaintances. If these averages became exact, how many greeting cards were exchanged?"

[*Cal Klater was very numerous: A. Nutt (the A stands for Anon), Richard Janney, E. P. Goodrich, Robert E. Philleo, Lyle Antenuff (Paul Hartman), Kum Pen (Walter Steinbruch), Anne Othernut (Charles Rathbun), John L. Nagle and Isidore Knobbe (Joseph S. Lambie). Those missing an early deadline were correct solutions for the traffic-circle problem from E. P. Goodrich, Wm. P. Murden and Neare Wright II (Allyn P. Bursley).*]

Parking Problems Cause Tax and Revenue Losses

CURB PARKING represents, in some cases, a cost to the municipality of $142 per month per car, according to L. S. Waterbury, M. ASCE, who recently completed a parking survey for the city of Fort Worth, Tex. Addressing the Texas Section of the Society on "The Parking Problem" as reported in the November issue of its official organ, *The Texas Engineer*, Mr. Waterbury pointed out that while great advances have been made in highway development in the past few years, little improvement has been achieved in terminal traffic accommodation.

In 1940, he said, the number of vehicles almost doubled that of 1920, and the mileage traveled by each vehicle almost doubled over the 1920's. But the street pattern in most of our cities remained unchanged. Consequently, we have severe congestion. The development in our cities has been on a vertical scale, with about the same street pattern. "The seriousness of the situation," Mr. Waterbury stated, "is appreciated when it is realized that in many cities the reduction and loss in taxable evaluation in the business district has been as much as 30 to 40 percent.

In Fort Worth, where a 25 percent increase in parking facilities can solve the problem, the survey indicates that off-street parking can be provided in a three-deck open garage at a cost of $500 per car. In San Francisco at Union Square, which accommodates 1,500 cars, the cost is $1,000 per car space.

All-Welded Vertical Lift Span Replaces Barge Bridge

By V. R. Gorham, Vice President
Cleary Bros. Construction Co.
West Palm Beach, Florida

THE old floating barge that carried highway traffic of State Route 71 across the Intracoastal Waterway at White City, Florida, has been replaced by a modern all-welded steel lift bridge constructed by our company.

The new bridge is designed for H-15 loading and is supported on concrete piles and piers. The overall length is 235′.

A total of 98 reinforced-concrete piles, 18″ square x 44′ long, were cast and driven to form the piers under the towers and the two end bents. Driving of pier piles was done from a barge with a Northwest crane fitted out with leads, using a No. 1 Vulcan Steam Hammer. For steel erection, the crane was fitted with a 95′ boom.

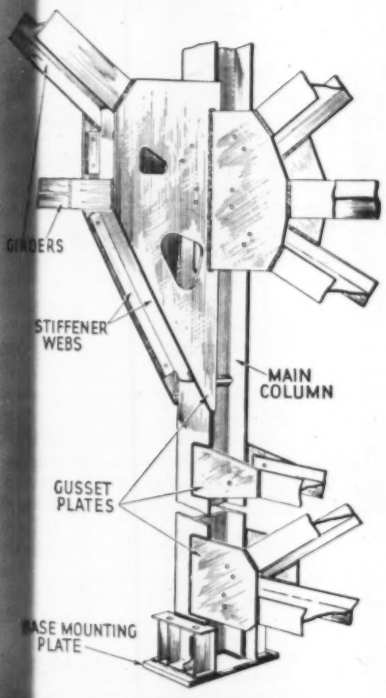


Fig. 1. Construction detail of main column at base foundation showing welded assembly of girders to column.

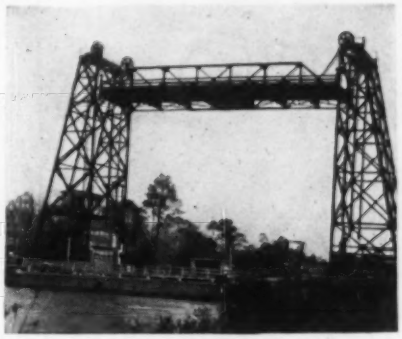


Fig. 2. Modern all-welded construction lift span bridge.

Pier forms were built of ¾″ sheeting with 2 x 6 studs on 16″ centers, and double 2 x 6 wales on 30″ centers for the average panels.

Steel for the towers and lift span was supplied by the Virginia Bridge Co. The two trusses for the 107′ lift span were already assembled when delivered, and the rest of the span welded together at the job site. Timber piles were driven in a nearby inlet, the span assembled and welded on this false-work, and then floated on two barges to its place in the bridge.

The trusses are 12′ 6″ high and are on 33′ 6″ centers. Near the bottom they are connected by 30″ 116-lb. I beams which are spaced 15′ apart and carry 14″ WF stringers. These stringers in turn support a 5″-thick concrete-filled steel deck grating.

The towers consist chiefly of 12″ WF 25 and 40-lb. beams. At the base each tower is 36′ 9″ wide x 28′ long. At the top the width is the same, but the slope on the back members cuts the length down to only 8′.

The weight of the lift span, including flooring and machinery, is 227,870 lbs. Theoretically the counterweights should have weighed half of this, or 113,935 lbs. each. Instead, the counterweights were made to weigh 109,940 lbs. each, with pockets for addition of balance blocks so the most efficient ratio could be worked out in actual tests.

"Fleetweld" electrodes and "Shield-Arc" welders, manufactured by The Lincoln Electric Company were used. The welders were of the engine-driven type with pneumatic tired running gear to provide easy portability.

The construction crew employed on the bridge averaged 23 men, consisting of a crane operator, 2 welders, 5 carpenters, 5 structural steel workers and 10 laborers. Had riveting been used, we would have required about 6 more men.

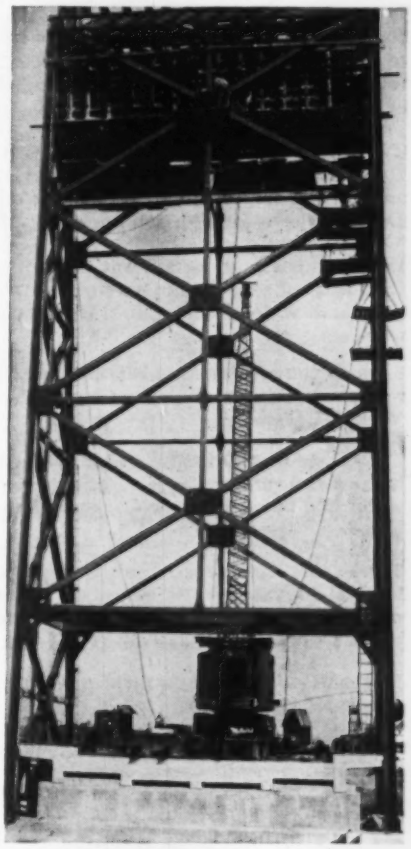


Fig. 3. All-welded steel tower assembled on concrete pier.

The above is published by LINCOLN ELECTRIC in the interests of progress.
Structural Design Studies are available free to architects and engineers. Write The Lincoln Electric Company, Dept. 151, Cleveland 1, Ohio.

Wool Gatherings by WOOLLEY

BASED ON MILES DRIVEN per fatality, 16-year-old drivers as a group have a record more than nine times worse than drivers 45 to 50 years of age.

TVA HAS ENOUGH water to supply power to its customers but not enough to satisfy operators of recreation facilities along its lakes.

THE 1947 WATER YEAR was characterized by excessive volumes of runoff over broad regions of the United States and Canada.

A NATURAL FLOW of one million gallons an hour or 25,000,000 gal per day from one water well is the largest in the United States. It is located in San Antonio, Tex.

THE MORMON TABERNACLE in Salt Lake City has been equipped with a new aluminum roof, consisting of almost 60,000 sq ft of preformed aluminum sheet.

DROUGHT IN GERMANY in the American zone has reduced hydroelectric-plant output to only 8 percent of the consumption in recent months compared to 60 percent a year ago.

THE HIGHEST and lowest points in the United States are in California, 60 miles apart. Mt. Whitney is 14,501 ft high and Death Valley is 300 ft below sea level.

IN 1946, collision, derailment and other train accidents resulted in only one passenger fatality for each 996,000,000 miles traveled.

SEVERE DROUGHT in October 1947 greatly restricted hydroelectric operations in New York and Maine.

TUNNELS CONSTRUCTED in connection with hydroelectric projects are not improvements within the meaning of the Canadian Taxation Act.

THE LAST Colorado Legislature passed laws giving the State Board of Health more power in enforcing standards for safe water supplies.

REGISTRATION OF ENGINEERS now totals nearly 115,000.

WELLS IN LONDON at Chiswick, Fulham and Hammersmith were overflowing a hundred years ago, whereas now the water level is about 250 ft below ground level.

THE OLD COMMON LAW of England is the basis of our present law relating to ownership of city streets.

INDUSTRY IS spending 450 million dollars a year on research now in contrast to the 80 million it averaged during the 1941–1945 period.

New Publications

Wind Waves. A 177-page book, entitled *Wind Waves at Sea, Breakers and Surf*, develops further the Navy Hydrographic Office series of publications on sea, swell and surf conditions, initiated during the war to give the Armed Services a basic knowledge about the oceans. Authors of the book, which is issued as Hydrographic Office Publication No. 602, are Henry B. Bigelow and W. T. Edmondson. Copies are for sale by the Hydrographic Office and the Superintendent of Documents, Washington 25, D.C., at a price of $2.80.

Welding Symbols. To keep pace with the growth of welding, the American Welding Society has issued a 1947 revision of *Standard Welding Symbols*. Representing the ultimate in simplification of presentation and improvement of nomenclature, the revision covers 34 of the processes used in various representative industries. Copies of the new standard, which is priced at 50 cents, may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N.Y.

Waterways Experiment Station. Issuance of three new Waterways Experiment Station bulletins has been announced by the Army Corps of Engineers. These are Bulletin No. 28, which reviews the "Practical Application of Experimental Hydraulics"; Bulletin No. 29, entitled "Certain Considerations in the Design of Flexible Pavements, Bases and Subgrades"; and Bulletin No. 30, which deals with "Air Entrainment in Concrete Design." Copies are available from the Waterways Experiment Station, Vicksburg, Miss., at a cost of $1 for Bulletins 28 and 30, and 75 cents for Bulletin No. 29.

Water Evaporation. Data relating to evaporation from water surfaces in California are presented in Bulletin No. 54 of the Division of Water Resources of the California Department of Public Works. The report, which was prepared by the late Arthur A. Young, Assoc. M. ASCE, summarizes pan records and coefficients developed during the period 1881–1946. Inquiries should be addressed to the California Department of Public Works, Sacramento, Calif.

Highway Research. Continuing its series on Current Road Problems, the Highway Research Board has revised its wartime pamphlet, "Recommended Practice for Treatment of Icy Pavements." Issued as Bulletin 9-R, the current revision takes into account the increasing use of chlorides in abrasives and gives the proper proportions for producing maximum results. The bulletin may be obtained from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Topographic Mapping. An index in map form showing the status of topographic mapping in the United States and its possessions has been prepared by the U.S. Geological Survey. The Survey has also published indexes showing the status of aerial photography and aerial mosaics in the United States. These indexes are available on request, without charge, from the Map Information Office, Geological Survey, Washington 25, D.C.

Traffic Congestion. A comprehensive study of local traffic congestion has been issued by the New Jersey State Highway Department under the title, "New Jersey's First Parkway Route 4." Impressively illustrated with photographs and charts, the report represents months of origin-and-destination studies by the State Highway Department in cooperation with the Public Roads Administration. Inquiries should be addressed to the State Highway Department, Trenton, N.J.

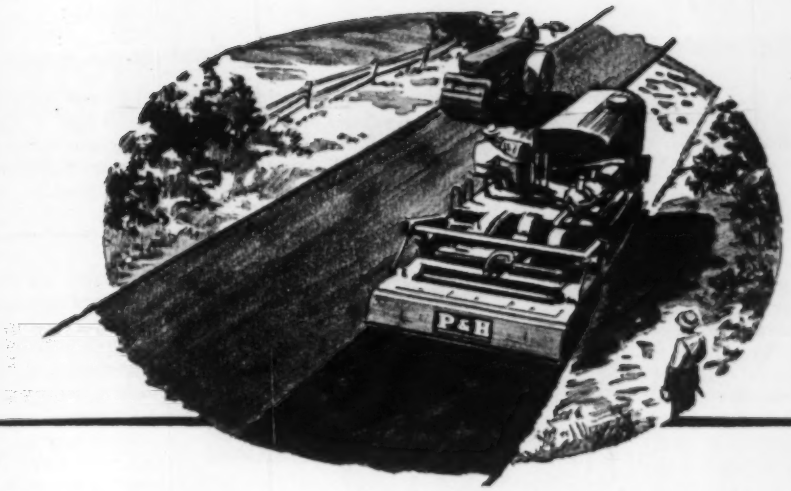
Plywood Standard. Detail grading requirements for exterior and interior types of Douglas fir plywood are covered in a revised standard, CS45-47, of the National Bureau of Standards. Copies are for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for 5 cents each. A discount of 25 percent will be allowed on orders for 100 or more copies.

Reservoir Sedimentation. Results of an investigation to determine the effects of sedimentation on the plan of operation of the reservoirs proposed by the Corps of Engineers for the Sacramento–San Joaquin Basin are detailed in Special Report No. 1 of the U.S. Soil Conservation Service. Estimates of the effect of sedimentation on the proposed reservoirs were based on surveys of sedimentation in 24 existing reservoirs in the drainage area. The report was prepared by Carl B. Brown, Assoc. M. ASCE, and Eldon M. Thorp. Inquiries should be addressed to the Sedimentation Section of the Soil Conservation Service, Washington, D.C.

Frost Action. To make available to American engineers a worth-while text on frost action with application to highways and railroads, the Technological Institute of Northwestern University has published Gunnar Beskow's *Soil Freezing and Frost Heaving*. J. O. Osterberg, Assoc. M. ASCE, is translator of the text, which represents the culmination of a ten-year period of exhaustive research sponsored by the Swedish government. Copies may be purchased at $3 each from the Technological Institute, Room 302, Northwestern University, Evanston, Ill.

Japanese Research. Several hundred paper-bound journals, representing a major portion of the issues of twelve different Japanese scientific research publications issued during the war, have been received by Carnegie Institute of Technology, Pittsburgh, Pa. The material may be borrowed by scientists and students, upon request to the Carnegie Tech library. About half the material has been translated into English; translation of the remainder must be arranged for by the borrower.

Water Sanitation. To aid sanitary engineers and health officials in evaluating sanitary features of water supplies with which they are concerned, the U.S. Public Health Service has made available a new "Manual of Recommended Water-Sanitation Practice" as Public Health Bulletin No. 296. A limited number of free copies are available for persons engaged in water-works sanitation from Public Health Inquiries Section



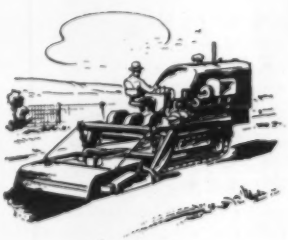
WHAT'S NEW *in Soil Stabilization?*

Developments in soil stabilized roads have come rapidly during the past few years. Scientific control of mixtures with native in-place materials now makes it possible to accurately predetermine load carrying capacities.

New speed and efficiency have also entered the picture with the development of the P & H Single Pass Stabilizer. Working under varying local conditions in widely scattered areas, these machines have proved their ability to fulfill these eight basic requirements of processing soils at a single pass — *with any type of admixture:*

1. Control processing depth for accurate proportioning
2. Pulverize the soil thoroughly
3. Blend materials uniformly
4. Create a true sub-grade
5. Disperse the liquid through the entire volume in measured quantity
6. Mix the coated material uniformly
7. Lay the completely processed material in a fluffy, even depth, ready for compaction
8. Do all these things in one pass — at a good rate of speed.

One typical example of P & H Single Pass Stabilizer performance is given at left. Highway Departments and Contractors interested in the most recent developments should write us for complete information.



Soil Bituminous Stabilization in Texas.

Two borrow soils, sand and light clay, were combined and mixed with 4% of RO4 (cut back asphalt) to a depth of 6" in a single operation. The P&H Single Pass Stabilizer's average production was 1264 square yards per hour while processing an 18 foot roadway in two nine foot lines — over a mile of roadway per day of 8½ hours.

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Office of Health Information, U.S. Public Health Service, Washington, D.C. Copies in quantity may be obtained from the Government Printing Office, Washington 25, D.C., at 15 cents each.

Technology in Palestine. Recent technological developments in the United States and Palestine are reviewed in the *Technion Yearbook 1947*. Authors include Arthur H. Compton, Nobel Prize winner in physics; Robert E. Doherty, president of the Carnegie Institute of Technology; Theodor von Karman, M. ASCE, director of the Daniel Guggenheim School of Aeronautics, California Institute of Technology; and Walter C. Lowdermilk, assistant chief, U.S. Soil Conservation Service. Inquiries should be addressed to the American Technion Society, 154 Nassau Street, New York 7, N.Y.

Maps. Maps of the Red River from Fulton, Ark., to the Mississippi River, prepared by the New Orleans District of the Corps of Engineers, are now for sale by the New Orleans District at a price of 50 cents. The series of 17 maps drawn to a scale of 1:62,000, includes Lower Old River, La.

Highway Traffic. Toll facilities and mathematical methods of measuring the influence of bridge tolls on traffic flow are discussed in *Toll Bridge Influence on Highway Traffic Operation*, by M. Earl Campbell. The 112-page volume, originally submitted as a thesis to the Yale University Bureau of Highway Traffic, has been published as Technical Report No. 2 by the Bureau.

Meetings and Conferences

American Concrete Institute. Inspection of the engineering laboratories of the Bureau of Reclamation and exhibits by the construction industry are highlights of the diversified program planned for the annual convention of the American Concrete Institute, to be held at the Shirley-Savoy Hotel, Denver, February 23–26. For details see the January issue of CIVIL ENGINEERING, page 71.

American Society of Mechanical Engineers. Papers on a wide variety of technical subjects have been scheduled for the spring meeting of the American Society of Mechanical Engineers, to be held at the St. Charles Hotel, New Orleans, La., March 1–4.

Associated Equipment Distributors. Present and anticipated problems facing the construction industry will be discussed at the 29th annual meeting of the Associated Equipment Distributors, scheduled for the Edgewater Beach Hotel, Chicago, February 15–19.

Associated General Contractors of America. The Adolphus and Baker hotels in Dallas, Tex., will be headquarters for the 29th annual convention of the Associated General Contractors of America, February 9–12. Requests for reservations should be addressed to Mr. William E. Woodruff, the Associated General Contractors of America, Munsey Building, Washington 4, D.C.

Minnesota Federation of Engineering Societies. The 15 member groups of the Minnesota Federation of Engineering Societies will stage their 26th annual engineering convention and third annual engineering exposition in St. Paul, Minn., February 11–14. Convention headquarters will be the Hotel Lowry, and the exhibit will be held in the Municipal Auditorium. Inquiries should be addressed to Federation Secretary Katherine A. Feucht, 1000 Guardian Building, St. Paul, Minn.

NEW IN Education

HOUSING RESEARCH at work will be the theme of the Third Annual Short Course in Residential Construction for Contractors and Builders to be held February 17 and 18 at the University of Illinois. The course will center around housing research being carried on at the University, including reports on the "industry-engineered house," seven of which have been built by the University. A time-and-motion study of construction techniques is being conducted on six of these houses to provide contractors with ways and means of reducing construction costs. The seventh house is serving as a laboratory for the study of coal handling, heating equipment, storage walls, and kitchen-laundry arrangements. Registrations and requests for information should be sent to the Division of University Extension, Urbana, Ill.

TRAFFIC COURT JUDGES and prosecutors will meet February 9 to 14 on the campus of the University of California at Berkeley in cooperation with the American Bar Association and Northwestern University Traffic Institute. This is the third conference of a series, the first of which was held in June 1947 at New York University. Also scheduled for the University of California is a course of specialized training for traffic police personnel opening at the Berkeley and Los Angeles campuses, respectively, on February 9 and February 23. Police from 11 western states are eligible to attend these courses offered by the university in cooperation with the Traffic Division of the International Association of Chiefs of Police.

TAU BETA PI fellowships for graduate study in engineering, amounting to $1,100 each, are open to all Tau Beta Pi members for the school year 1948–1949. Application forms must be mailed by February 29, 1948. For information write to Paul H. Robbins, Director of Fellowships, 1359 Connecticut Avenue, N.W. Washington 6, D.C.

OHIO STATE UNIVERSITY has established a Department of Welding Engineering, the first of its kind in the nation, according to an announcement by the university's president, Howard L. Bevis. The new department, which is in the College of Engineering, will offer undergraduate work leading to the degree of Bachelor of Welding Engineering and advanced study for graduate engineers.

REORGANIZATION OF the scientific library of the Naval Postgraduate School, Annapolis, Md., has been effected by cataloging and reclassifying the material according to the latest methods, featuring special classification adaptations for Aeronautics, Electrical Engineering, Radio and Electronics, and Nuclear Physics, and using Library of Congress printed cards extensively. The firm which did this reorganization work, Technical Library Consultants, Inc., has prepared a library manual which may be obtained by readers of CIVIL ENGINEERING free on request to its New York City address, [illegible] Madison Avenue, New York 17, N.Y.

Overproduction of Engineers Not Likely Says Columbia Dean

UNLESS THE PRESENT unreasonably large enrolment in engineering is long continued there is little fear that American schools will overproduce in turning out future engineers. This opinion was expressed by James P. Finch, M. ASCE, dean of Columbia University's School of Engineering, in his annual report to the university. "The country today needs trained engineers more than ever before," Dean Finch stated. "The impetus of war on engineering and industrial development is reflected in the unprecedented long-range demand for technical men."

One result of the war, as observed at Columbia's School of Engineering, has been "a very remarkable shift in student interest to industrial engineering, according to Dean Finch. The department of industrial engineering, although one of the smallest in the school before the war, now claims the largest registration. The Columbia School of Engineering, which is continuing to emphasize graduate and research study, has endeavored to provide this specialized training while insisting on basic science and engineering courses required of all students," he asserted.

Dean Finch charged the profession with failure "to make clear to the public and those interested in furthering research the fact that adequate support for research in engineering science is essential if technology is to maintain its services to mankind." This is of vital importance, he contended, that fundamental research in engineering be continued.

Chicago Blighted Area Gives Way to Modern Campus

ONE OF THE NATION'S most blighted areas is being transformed into one of the most modern centers of technological education and research under the impetus of the $15,000,000 building program of Illinois Institute of Technology. A component of the overall development program is a complete housing plan to make the 100-acre Technology Center campus in Chicago a cohesive study-work-and-live unit. More than 10,000 persons will live, work or study within the area.

Three buildings in the program are

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solves finishing problem on pitched slab and curve elevations: A true power trowel — where slab is pitched you simply set the rear screed at whatever angle is needed to carry the material uphill and compact it solidly against the upper form. Eliminates or greatly reduces carry-back; you save one to two shovelers' wages on every job.

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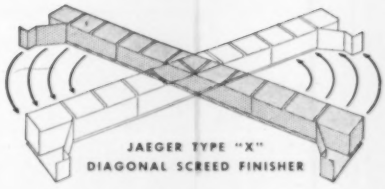
greater capacity to match any paver: Because the rear screed works at an angle against the final roll of material and at a wide range of speeds, *all independent of traction*, stiff mixes are more easily finished without tearing. Helps to eliminate extra passes, easily keeps pace with dual drum pavers on half-width as well as full-width slab.

job-tested for 18 months — now available for 1948 work: 10-15 and 20-25 ft. widths with quick crown change screeds standard. See your Jaeger distributor immediately or write for Specification FX-8.



Front Screed is Transverse, Rear Screed is Diagonal:

Hand wheel, on operator's platform, quickly swings pivoted screed in either direction to operate at whatever angle best suits the work.

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"DUAL-MIX" TRUCK MIXERS, AGITATORS — HOISTING ENGINES, SELF-RAISING TOWERS — CONCRETE AND BITUMINOUS PAVING EQUIPMENT

ready completed and in use—a metals research building, a wing of the Engineering Research Building, and Alumni Memorial Hall. Now being completed are a chemistry building and a metallurgical and chemical engineering building. Under construction are two four-story student dormitories, part of the Institute's program for housing students, staff and families in permanent apartment, residence, and dormitory dwellings adjacent to the campus. Besides these buildings, 59 additional academic, laboratory, campus and housing structures will be erected over a five-year period.

Pre-Engineering Training in Liberal Arts Colleges Recommended

THAT THE LIBERAL ARTS college should have an important role in engineering education was the theme of an address by Arthur G. Hayden, M. ASCE, delivered at Ripon College's celebration inaugurating its "Second Century Program." On that occasion Mr. Hayden received a citation "in recognition of outstanding ability and distinguished accomplishment in the field of engineering." His experience in the educational field includes membership on the Committee on Juniors of the ASCE Metropolitan Section, membership on the ASCE Committee on Student Chapters, the chairmanship of the Committee on Student Guidance of the ASCE Metropolitan Section, and the chairmanship of the New York Engineers' Committee on Student Guidance (under the auspices of ECPD).

More liberal arts colleges should follow the example of Ripon and make cooperative agreements with engineering colleges, Mr. Hayden stated in his address. Ripon is one of 12 such colleges which have a cooperative agreement with MIT whereby students spend five or six years divided between the two institutions and acquire both an A.B. and an S.B. degree. The mortality rate of such students in the engineering school, Mr. Hayden said, has been reduced to 10 percent or less as compared with the general average of over 60 percent—a convincing demonstration. Excerpts from his address follow:

"A deplorable state of affairs exists in the field of engineering education. A nationwide survey showed that more than 60 percent of those who enter engineering colleges fail to graduate and that about 40 percent of the graduates fall by the wayside in the profession itself. The total mortality is thus about 75 percent. This is a sad loss of the best years of a young man's life.

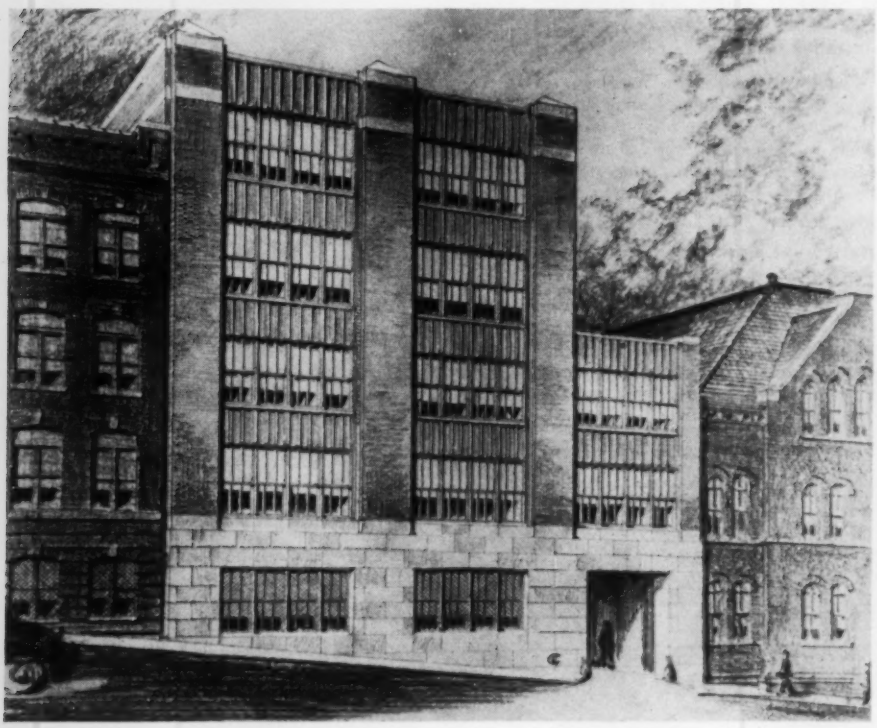
"A fundamental mistake is made in the habit of sending high school graduates directly into engineering colleges without intermediate training. The high school graduate is usually too immature and often ill-informed to know for sure what he is best fitted for. In addition he finds himself in an atmosphere that does not stimulate interest in cultural subjects. These are taught better in the liberal arts colleges where they are regarded as of prime importance and not as frills.

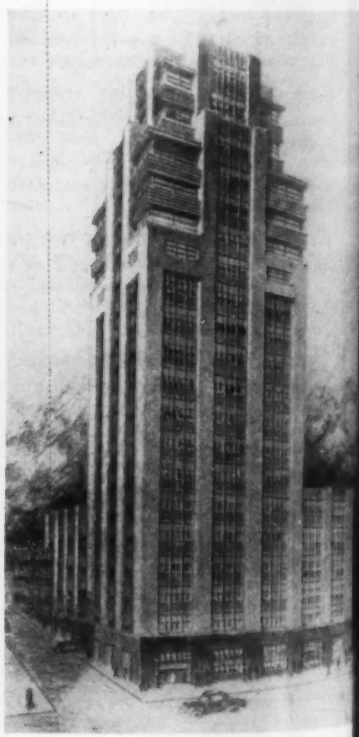
"The liberal arts colleges should establish 'pre-engineering' courses to include the non-technical fundamentals underlying an engineering education and selected 'cultural' subjects. No subjects in addition to those usually offered in liberal arts curricula need be established but existing subjects can be grouped so as to constitute formal pre-engineering courses that will have a psychological effect in attracting students. The pre-engineering course should also include orientation lecture courses by engineers who can explain what engineering is, what the engineer does, and what qualities and mental aptitudes are necessary for success in the profession. The average student is woefully ignorant on this subject.

"Orientation will be more effective in college pre-professional courses than in high schools. If the student decides that he does not want to be an engineer, little is lost because his course is useful in a wide field outside of engineering."

Newark College Starts $2,700,000 Building Program

DESIGNED TO HOUSE most modern of engineering laboratory equipment, addition to Newark College of Engineering is placed under construction with award of contracts totaling $500,000. Final laboratory structure (below, left), containing facilities for professional offices, will centralize all phases of college's work for benefit of New Jersey industry. College's $2,700,000 building program, thus initiated, also includes Tower Building (below, right), 20-story structure for future construction to house college offices, classrooms, gymnasium, technical libraries, museum, and professional offices.



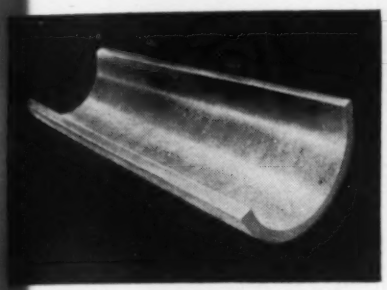


Engineering Facts about

Johns-Manville TRANSITE PRESSURE PIPE

Carrying Capacity

EXAMINATION of the interior wall of Transite* Pressure Pipe will quickly disclose its uniformly smooth surface. This smoothness, imparted during manufacture by forming each length under pressure on a highly polished steel mandrel, accounts for the high flow coefficient of Transite Pressure Pipe—C=140, based on the Williams and Hazen formula.



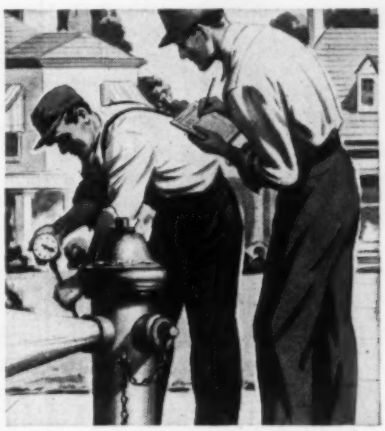
The unretouched photograph above shows Transite's exceptionally smooth interior surface—imparted by the polished steel mandrel on which the pipe is made.

Moreover, because Transite is made of asbestos and cement, it is inherently and completely immune to tuberculation. This means that the initial high carrying capacity of this pipe remains high in service—a fact which has been confirmed by accurate Pitometer tests.

One important advantage of Transite's maintained high carrying capacity is the assurance of an ample flow of water for both normal and fire-fighting needs in the years to come. Pumping equipment can be operated closer to peak efficiency; pumping costs can be held to a minimum. Taxpayers can receive the benefits of the favorable fire insurance rates which result from a modern, efficient water distribution system of ample capacity.

Accurate Pitometer tests conducted in the field verify Transite's maintained carrying capacity of C=140.

Another advantage—the engineer may design his water system with pipe of minimum diameter, rather than resort to larger pipe than would otherwise be necessary in order to offset the progressive reduction in flow caused by tuberculation. This practice is not necessary when Transite Pressure Pipe is specified.



As indicated by tests, Transite's *maintained* carrying capacity helps provide the abundant fire-flow essential to adequate protection and to favorable fire insurance rates.

And, of course, since tuberculation is not a problem, the costly expense otherwise involved in cleaning and lining of water mains can be eliminated.

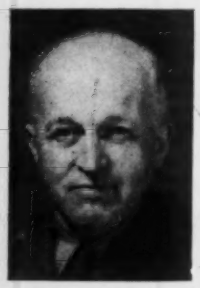
A maintained high-carrying capacity is one of many advantages of Transite—the modern asbestos-cement pipe that was engineered to carry water more efficiently and more economically. For further facts, write for Brochure TR-11A. Address Johns-Manville, Box 290, New York 16, New York.

*Transite is a registered Johns-Manville Trade Mark

JOHNS-MANVILLE JM PRODUCTS

NEWS OF Engineers

Frank A. Kittredge, for the past six years superintendent of Yosemite National Park, has been appointed chief engineer of the National Park Service, with headquarters in Washington, D.C. From 1917 to 1927 Mr. Kittredge was senior highway engineer for the U.S. Bureau of Public Roads (now the Public Roads Administration), and since the latter date he has been with the Park Service. Mr. Kittredge's achievements for the Park Service include the establishment of the Kings Canyon National Park and the Olympic National Park and construction of the Going-to-the-Sun Highway crossing Glacier National Park. In his new capacity, he will be assistant chief of development in charge of engineering activities throughout the Park Service.



F. A. Kittredge

Alex Van Praag, Jr., consulting engineer of Decatur, Ill., has been elected president of the National Society of Professional Engineers. ASCE members elected vice-presidents in the organization are **William Ryan,** Boston, Mass.; **Lawrence Peterson,** Milwaukee, Wis.; and **Robert Coltharp,** Austin, Tex.

Nathan L. Smith, who retired early in January as director of the Baltimore, Md., Department of Public Works, has accepted a position as engineering consultant to the city. He has also been offered the post of chief engineer of the Baltimore County Metropolitan District.

James K. Searcy has been transferred from the position of office engineer in the Jackson, Miss., district office of the U.S. Geological Survey to Rolla, Mo., where he will serve in a similar capacity. Mr. Searcy was in the Army during the war, attaining the rank of major in the Coast Artillery Corps.

Alexander Lyle is now superintendent for the George H. Flinn Corp. on subway construction in Philadelphia. He was previously chief engineer for the Carleton Co., Inc., on similar construction work in New York City.

Earl L. Mosley has been appointed to the newly created post of utilities director for Denver, Colo. Mr. Mosley recently resigned as city manager of Colorado Springs, Colo.

Dean G. Edwards and **Guy Kelcey,** New York City consultants under the firm name of Edwards & Kelcey, have opened an engineering office in Newark, N.J.

Edwin A. Fisher, Hon. M. ASCE, and former Society Director, Rochester, N.Y., who celebrated his 100th birthday last July 21, sent to Society Headquarters his regrets that he was unable to attend the Past and Active Officers' Dinner preceding the Annual Meeting. In the communication Mr. Fisher, who reports recovering from an illness that hospitalized him for a month, asked to be remembered to his many friends in attendance at the dinner, and that they be assured he was thinking of them.

John J. Theobald has been promoted from the position of associate professor of civil engineering at the City College of New York to a full professorship.

Evan W. Vaughan is now associate professor of civil engineering at Syracuse University. Until recently he was senior civil engineer in the Water Resources Division of the U.S. Engineer Office at Sacramento, Calif.

John G. Hotchkiss has resigned as structural design engineer for Sanderson & Porter, engineers and constructors of New York City, to join the staff of the American Institute of Steel Construction, Inc., as district engineer for the metropolitan New York area.

Ivan R. Jensen, previously instructor in aeronautical engineering at Iowa State College, has become associate professor of civil engineering at the University of North Dakota.

J. S. Dodds, professor of civil engineering at Iowa State College, received a distinguished service certificate "for his contributions to the field of engineering" at the annual meeting of the National Council of State Boards of Engineering Examiners. Professor Dodds is a past-president of the NCSBEE, and has been a member of the Iowa State Board of Engineering Examiners since 1927.

Carlos Lopez, civil engineer of Quito, Ecuador, and vice-president of the Sociedad de Ingenieros y Arquitectos del Ecuador, headed the official Ecuadorian delegation that assisted in the organization of the Sixth Pan-American Congress of Architects recently held in Lima, Peru. Mr. Lopez served on numerous organizational committees and was invited to give the official address at the opening of the Exposition of Painting and Sculpture.

Carlos Lopez

O. W. Crowley, executive secretary of the central branch of the Associated General Contractors of America, is "cited for service" in a recent article in *Construction Methods,* which outlines his many activities in behalf of contractors in the state of Iowa since he helped organize the Associated General Contractors of America in 1923.

Don Johnstone has recently been named assistant director of Associated Architects-Engineers, and is stationed at their Los Alamos (N.Mex.) office. Former editor of CIVIL ENGINEERING, Mr. Johnstone was recently on the staff of Ohio State University and the Scioto-Sandusky Conservancy District, Columbus, Ohio. During the war he served as a commander in the U.S. Civil Engineer Corps.

H. R. McDonald, of the U.S. Geological Survey, was recently named liaison officer between the Survey and the U.S. Bureau of Reclamation, with headquarters in Denver, Colo. Mr. McDonald was formerly in the Phoenix, Ariz., office of the Survey.

Thorndike Saville, dean of the New York University College of Engineering, has been appointed by Governor Dewey to serve on the eight-member New York State Public Health Council, filling the unexpired term of the late **Henry Neely Ogden,** M. ASCE. The council advises the Commissioner of Health on various public health matters including additions and amendments to the State Sanitary Code. Dean Saville, who has just completed a term as Director of the ASCE, has held his present post at New York University since 1936.

Thorndike Saville

C. L. Wartelle has resigned as city engineer of Seattle, Wash., because of poor health, but will serve for a time as consultant to the city engineering department. An employee of the department since 1910, Mr. Wartelle has been city engineer since 1938.

J. F. Friedkin, engineer for the International Boundary and Water Commission, has been assigned by the U.S. Public Health Service to make an investigation of the Lower Tijuana Sanitation District.

John E. Kiker has severed his connection as district sanitary engineer for the New York State Department of Health at Poughkeepsie, N.Y., to become professor of sanitary engineering at the University of Florida. Other additions to the civil engineering department there include **D. A. Firmage,** formerly on the U.S. Engineer Board at Fort Belvoir, Va., and **George Grantham,** previously instructor in civil engineering at the Illinois Institute of Technology.

Charles K. Bartholomew is now in the Bureau of Bridges and Grade Crossings of the New York State Department of Public Works, Albany, N.Y. Other changes in the department include the promotion of **Eric Norton** from senior claims engineer to associate civil engineer. Mr. Norton has been transferred from Albany to Buffalo.

Col. Mason J. Young has been assigned as division engineer of the South Atlantic Division of the Army Engineer Corps, with Atlanta, Ga. He succeeds **Col. George Gillette,** who recently retired from the Army to accept an appointment as executive director of the North Carolina Ports Authority.

Arthur C. Jenkins has opened a consulting office at 870 Market Street, San Francisco, Calif., where he will specialize in transportation engineering and economics. For the transportation research engineer and examiner for the California Railroad Commission, Mr. Jenkins served as a commander in the Navy during the war.

George S. Armstrong, president of George Corp., Tampa, Fla., has formed the Erickson Bay Bridge, and for several

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George S. Armstrong, president of George S. Armstrong & Co., Inc., New York City, has been appointed chairman of the business management engineers division of the Committee for Economic Development.

Harry A. Blake, previously on the engineering staff of the American Bridge Co., Columbus, Ohio, has opened an office in Cincinnati, Ohio. He offers a complete structural design and consulting service on steel and concrete bridges, buildings, foundations, and unusual structures of every description.

Charles H. Wagner, until lately chief of construction in the Nashville District of the U.S. Engineer Office, has been appointed project engineer on the Harlan County Dam, located on the Republican River near Alma, Nebr. The dam will be an integral part of the Pick-Sloan Plan.

Robert E. McLaughlin has resigned as chief engineer for McCloskey & Co., Philadelphia building construction company, to go into private practice as a structural engineer. Prior to this connection with McCloskey & Co., Mr. McLaughlin was structural engineer for the Philadelphia School District.

Don M. Forester, for the past two years project engineer for the U.S. Bureau of Reclamation on the San Luis Valley Project in Colorado, is now construction engineer for the Bureau on the Shadehill Dam project on the Grand River near Lemmon, S.Dak.

Harold A. Wilde, assistant district airport engineer for the Civil Aeronautics Authority at Atlanta, Ga., has been transferred to Jacksonville, Fla., where he will assume the position of district airport engineer.

William H. Kershaw recently retired as assistant general sales manager of the Texas Co., New York City, after 37 years of service with the organization. He was appointed assistant sales manager in 1936 and assumed general administrative duties. For years Mr. Kershaw has supervised the company's advertising activities, particularly in the field of radio.

Alfred E. Johnson, veteran employee in the Arkansas State Highway Commission, has been named chief engineer to fill the vacancy caused by the death of **W. W. Zass,** M. ASCE. Joining the commission 20 years ago, Mr. Johnson has served as office engineer and, for the past six years, as assistant chief engineer.

John C. Seeley, of Ann Arbor, Mich., has been made a member of the Ann Arbor consulting firm of Shoecraft, Drury & McNamee, which has been reorganized under the name of Drury, McNamee & Porter. Mr. Seeley has been on the staff of the firm for the past eleven years. In additon to Mr. Seeley, present active members of the firm are **Walter R. Drury, Robert L. McNamee,** and **Samuel D. Porter,** Members ASCE. **W. C. Hoad** and **E. C. Shoecraft,** Members ASCE, will remain as members of the firm in an inactive status.

Charles Haydock, Philadelphia consultant, has been appointed a member of the Pennsylvania State Registration Board for Professional Engineers by Governor James H. Duff.

Ole P. Erickson, until lately in charge of engineering and operation for the Hendry Corp., Tampa, Fla., has formed the Erickson Engineering Co. in Tampa. Under Mr. Erickson's supervision, many improvements to hydraulic dredges and equipment, particularly rock dredging, have been developed. His new company will specialize in dredge design and special dredging problems.

John B. McMorran was recently appointed Rochester district engineer of the New York State Department of Public Works. Mr. McMorran has been in the state service since 1919, becoming assistant district engineer at Binghamton in 1942. A veteran of both World Wars, he directed construction of air fields and hospitals in the South Pacific during the recent war, attaining the rank of lieutenant colonel.

Howard P. Maxton was recently elected secretary and assistant treasurer of the Raymond Concrete Pile Co., New York City. Prior to joining the Raymond Concrete Pile Company in 1945, Mr. Maxton was in the contracts section of the Navy Bureau of Yards and Docks, Washington, D.C.

Deceased

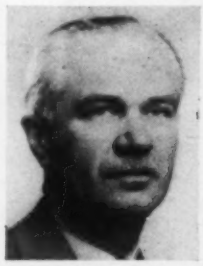
Murray Chase Ayers (Assoc. M. '17) senior structural engineer for the Los Angeles County Department of Building and Safety, Los Angeles, Calif., died suddenly on November 24. Mr. Ayers, who was 63, spent his early career on the construction of railroads and irrigation works in Hawaii. Later he was with the California Division of Highways, and structural designer and engineer for several Los Angeles consulting firms. He had been in the Los Angeles County Building Department since 1933.

Frank Sawin Bailey (Assoc. M. '27) of North Weymouth, Mass., died on January 21, 1947, though the Society has just heard of his death. He was 74. Mr. Bailey had been with Metcalf & Eddy, Boston; the New England Power Association, Boston; the Procurement Division of the Treasury Department, Washington, D.C.; and the Detroit (Mich.) City Engineer's Office. More recently he was with the Stone & Webster Engineering Corp., Boston.

George Everett Baker (M. '18) city engineer of Long Beach, Calif., died there recently. Mr. Baker, who was 66, was in the engineering service of Long Beach from 1923 until 1929 and from 1939 until his death. From 1929 until his return to city service he was with the Metropolitan Water District of Southern California, serving as engineer in charge of the location of the aqueduct and as resident engineer at Los Angeles. He had been city engineer of Long Beach since 1929 and was director of public service from 1939 until the two offices were separated in 1944.

Kenneth Kevin Bickford (Jun. '38) chief inspector in the Construction Department of the City Housing Authority, Oakland, Calif., died on November 23. He was 34 and an alumnus of the University of Santa Clara, class of 1935. Mr. Bickford was junior bridge engineer and inspector on the construction of the San Francisco–Oakland Bay Bridge, and for several years prior his death had been in the Oakland Housing Authority.

Charles Felix Lovan (M. '39) engineer and contractor of Jacksonville, Fla., was killed just before Christmas in the crash of a private plane near Jacksonville.



Charles Felix Lovan

He was 46. From 1936 to 1937 Mr. Lovan was with the Solvay Process Co., at Hopewell, Va., in charge of field engineering as a foreman in charge of operation of ammonia plant. Since the latter year he had been a member of the Jacksonville engineering and contracting firm, Hillyer & Lovan. Mr. Lovan had just been appointed chairman of the ASCE Construction Division's Committee on Construction Contracts and Specifications and ASCE representative to the Associated General Contractors Committee on Construction Contracts and Specifications. He was a former president of the Florida Section.

George Robert Ure Buchanan (Assoc. M. '14) of Havana, Cuba, died recently at the age of 71. A Canadian by birth, Mr. Buchanan spent most of his career in Cuba. He had been in the engineering department of the City of Santiago and, beginning in 1902, was for many years with the Cuba Cruz Construction Co., in charge of railroad and other construction projects.

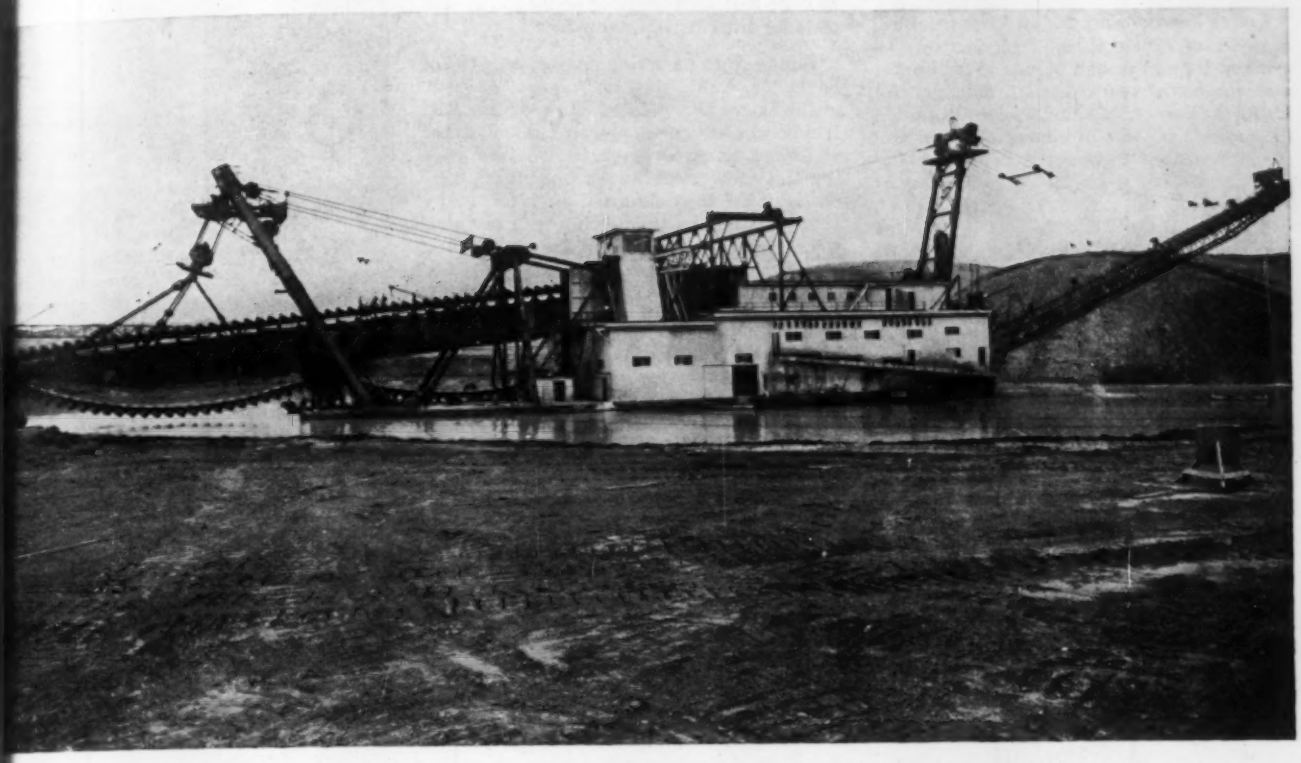
John Fletcher Byxbee (M. '28) consulting engineer for the City of Palo Alto, Calif., died on October 28, at the age of 70. Mr. Byxbee was city engineer of Palo Alto from 1906 until his retirement from active service in 1941. Since the latter date he had been acting in a consulting capacity and as a member of the planning commission. Mr. Byxbee's achievements during his long tenure as city engineer include a planned program of land acquisition and harbor improvement, the public utility system, and grade separations.

Hugh William Crawford (M. '23) civil engineer for the Phillips Petroleum Co., Bartlesville, Okla., died recently. Mr. Crawford, who was 60, had been with the Phillips Petroleum Co. since 1930. Earlier in his career he was city engineer of Independence, Kans., and Ponca City, Okla., and sales engineer for the Texas Co. During the first World War, he served overseas with the rank of captain.

Wilton Joseph Darrow (M. '13) of Los Angeles, Calif., died in June 1945, according to word just received at Society Headquarters. He was 69. Mr. Darrow had been with the American Bridge Co. and had worked on the structural design of Grand Central Station in New York. For some years he was a member of the New York consulting firm of Balcom & Darrow, and more recently had been concrete designing engineer for the Southwestern Engineering Co., Los Angeles.

Douglass Hewitt Ferry (Assoc. M. '[illegible]) consulting engineer of San Jose, Calif., died at his home there on November 25. He was

YUBA BUCKET LINE DREDGES for DEEP DREDGING



Yuba Consolidated Gold Fields Dredge No. 20 operated at Hammonton, California, since 1939. It was designed and built by Yuba Manufacturing Company and has 18 cu. ft. buckets to dig 124 feet below water level. The digging ladder is 216 feet long between centers of lower and upper tumblers. This is the largest and deepest digging placer dredge built in the United States to date for use anywhere in the world.

Placer gravels are dredged successfully with Yuba dredges from a depth of 174 feet below ground level. The problems of deep dredging for gold have been overcome in California where six huge Yuba dredges have dug at depths ranging from 80 to 100 feet below the top of the bank. Two other Yubas dig 112 and 124 feet, respectively, below water level and carry banks, if necessary, that are 30 to 50 feet in height. All of these are operated by Yuba Consolidated Gold Fields and some have been operated in ground which has been dredged once and sometimes twice before. They are reaching deeper deposits and at the same time handling old tailings.

The two largest Yubas in California displace over 4,000 tons each in operating conditions. Such tremendous weights and powerful machinery demand the best in designing skill and operating management. The experience gained in California has been utilized also by Yuba in designing deep digging dredges for tin mining in Malaya. The first large modern dredge in that area was Yuba No. 86 built in 1929. A new standard for performance was established in the tin dredging industry by the work of No. 86. It produced an assigned monthly quota in less than a week and thereby led many operators to reconsider their properties in the light of greater production.

The California gold dredging industry has been a steady producer of new wealth for a period now approaching its fiftieth anniversary. The greater part of placer gold bearing ground is of little value for any use other than mining. Gravel bars, benches and old river channels, made up of material washed down from higher elevations, carry gold which is mined by dredging.

An important part of river dredging in California is done in cooperation with state and federal authorities. Levees built during gold dredging operations confine rivers to deeper channels and help to minimize the overflowing of streams like the Yuba and Feather Rivers. Other areas are protected from flood waters which in the past have reduced good orchard land to silt covered waste deposited there by currents carrying naturally eroded material from upstream sources.

Yuba's experience includes the design and construction of placer mining dredges for special operating conditions. You can consult the Yuba organization concerning any bucket ladder dredging problem with assurance that full and accurate information will be furnished.

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YUBA DREDGES — PROVED DEPENDABILITY ROUND THE WORLD

61. Mr. Ferry spent his early career in mining engineering in the Yukon Territory, and later represented various Canadian mining interests in California, Oregon, and Idaho. At one time he had a consulting practice at Rouge River, Ore.

Pierce Powers Furber (M. '23) structural engineer of Philadelphia, Pa., died on December 19, at the age of 62. Mr. Furber was for some years district manager for C. A. P. Turner, M. ASCE, consulting engineer, and he was in charge of structural design for Stone & Webster, Boston, on improvements made to the U.S. Arsenal at Rock Island, Ill., during World War I. More recently he had been with United Engineers & Constructors, Philadelphia, on a variety of construction assignments.

Howard Allen Glenn (Assoc. M. '39) vice-president of the Standard Bitulithic Co., New York, N.Y., died at his home in West Orange, N. J., on November 26. His age was 53. Mr. Glenn was a road contractor before he joined the Standard Bitulithic Co. ten years ago.

Henri Edward Gruner (M. '25) consulting engineer of Basel, Switzerland, died on November 28, at the age of 74. Widely known as a hydraulics expert, Dr. Gruner had had a consulting practice in Basel since 1913. He designed and directed construction of the hydroelectric power station at Broc and of the Allbruck-Dogern power plant on the Rhine. He had served as consultant to most of the Central European governments and recently advised the Egyptian government on projects for the power development of the Nile. He was one of the founders of the hydraulic laboratory at the Federal Technical University at Zurich, and sponsored research work on snow in his soils mechanics laboratory at Allbruck.

Sam Graham Porter (M.' 11) retired manager of the Department of Natural Resources, Canadian Pacific Railway, Calgary, Alberta, died in Calgary recently. Mr. Porter, who was 72, was born and educated in the United States, going to Canada in 1913 as irrigation expert for the Dominion government. In 1918 he joined the Canadian Pacific Railway as superintendent of operation and maintenance of the company's Lethbridge irrigation system. In 1925 he was appointed assistant manager of the Department of Natural Resources, and from 1927 until his retirement in 1942 was manager of the department. A pioneer in the development of Alberta's irrigation system, Mr. Porter was the first Alberta man to be elected president of the Engineering Institute of Canada.

Sam G. Porter

Stanley Moore Hands (M. '46) testing engineer for the City of Oakland, Calif., died on November 7, at the age of 59. A veteran of the first World War, Mr. Hands had been city engineer of Iowa City, Iowa, and for some years was president and general manager of the River Products Co., Iowa City. Later he served as engineer of special investigations for the materials and research department of the California State Division of Highways on the San Francisco–Oakland Bay Bridge project, and since 1938 he had been engineer of materials and tests for the City of Oakland.

James Norman Irving (Assoc. M. '18) of Riverside, Calif., died on August 11, 1947, at the age of 67. A Canadian by birth, Mr. Irving was educated in the United States and spent his career here. He had been with the U.S. Geological Survey on irrigation investigations in California, and for many years was on the engineering staff of Quinton, Code & Hill, Los Angeles consultants.

Robert Athole MacGregor (M. '10) retired civil engineer of New York City, died at his home there on December 9, at the age of 80. Born in Scotland, Mr. MacGregor came to this country as a young man. He was in the service of the City of New York from 1897 until his retirement in 1935. He had been division engineer in the Office of the Borough President of Manhattan, and for some years prior to his retirement was engineer in charge of maintenance for the Borough of Manhattan.

Jeffrey Burland MacPhail (M. '46) hydraulic engineer for the Shawinigan Water & Power Co., Montreal, Canada, died suddenly at his home there on December 22. He was 53. During the first World War, Mr. MacPhail served overseas with the Royal Canadian Engineers, rising through the ranks from private to major. Joining the Shawinigan Water & Power Co. at the end of the war, he became known throughout Canada as an investigator and designer of hydroelectric plants.

James Rossa McCormick (Assoc M. '20) of Scranton, Pa., died on September 27, at the age of 69. Mr. McCormick had been superintendent of construction and resident engineer in charge of building county roads at Scranton, and he was for a number of years resident engineer for the Philadelphia firm of Ballinger & Perrot on construction projects all over the East.

Benjamin McKeen (M. '95) retired vice-president of the Pennsylvania Railroad, St. Louis, Mo., died at his home in that city on December 16. Mr. McKeen, who was 83, had a long career in railroad engineering, beginning as a draftsman for the Vandalia Railroad in 1885. Later he became general manager of the Pennsylvania Railroad, with headquarters in Pittsburgh, and in 1920 was transferred to St. Louis as vice-president in charge of the Western lines of the railroad. He retired in 1934.

James Warren Pearl (M. '89) of Chicago, Ill., died recently at the age of 90. As chief engineer for various bridge-building companies, Mr. Pearl was in charge of the design and construction of many highway and railroad bridges, including the three-hinged wrought-iron arch over the Salmon River at Pulaski, N.Y. He built the first reinforced concrete arch in America in 1892, and designed the river section of the La Salle Street Tunnel, Chicago, in 1910. Author of many technical articles, Mr. Pearl spent his later years on research on improved sedimentation processes.

William Walter Zass (M. '27) chief engineer for the Arkansas State Highway Department for the past 15 years, died suddenly at his home in Little Rock, Ark., December 12. Mr. Zass, who was [illegible] had been with the State Highway Department since 19[illegible] and had served as chief engineer since 1932. A veteran of both World Wars, Mr. Zass served in the Engineer Corps during the recent war, on the Persian Gulf Command on the construction of military roads in Iran. Upon his discharge from the Army with the rank of colonel, he returned to his position with the highway department. Long prominent in the Mid-South Section of the Society, Mr. Zass served as president in 1940.

W. W. Zass

Harry Matthew Steward (M. '18) former superintendent of maintenance for the Boston Elevated Railway, died in Medford, Mass., on January 3. His age was 75. Mr. Steward became connected with the Boston Elevated Railway in 1903, and served as superintendent of maintenance from 19[illegible] until his retirement last April. For 11 years prior to 1903 he was in the engineering department of the Boston & Maine Railroad.

Charles Arthur Strong (M. '30) president of Strong & Macdonald, Inc., Tacoma, Wash, died on December 13. Mr. Strong, who was 64, was superintendent of the Yukon Gold Co. from 1908 to 1912 and general superintendent of the Tacoma Dredging Co. from 1912 to 1919. Since 1921 he had been president of the Tacoma consulting firm of Strong & Macdonald.

William Mellor Sutcliffe (Assoc. M. '40) engineer for Bay Village, Ohio, died in a hospital in Cleveland on December 9. Mr. Sutcliffe, who was 44, had been engineer of Bay Village for the past 16 years. He was recently given an "outstanding citizen award" by the Bay Village Men's Club which cited him as "a valued consultant in many branches of the village's administration."

Harry Ramon Trevor (Assoc. M. '32) of San Francisco, Calif., was drowned in the Pacific on May 3, 1947, in an attempt to rescue two boys from the surf, according to an announcement just received at Society Headquarters. His age was 63. A native of England, Mr. Trevor spent his early career in railroad location engineering around Seattle, Wash. Beginning in 1934, he was with the San Francisco Engineering Department for a number of years.

Sanders Van Auken (Assoc. M. '22) of Oakland, Calif., died recently at the age of 69. A specialist in the design of ship facilities and cargo-handling gear, Mr. Van Auken had been with the Newport News Shipbuilding & Dry Dock Co., the Seattle Construction and Dry Dock Co., the U.S. Navy Yard at Bremerton, Wash., and the Mare Island Navy Yard. More recently he was with the New York Shipbuilding Co., Camden, N. J., and naval architect for the Transport Command, Fort Mason, Calif.

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Grouted Gravel Fill and Precast Slabs for Barker Dam

(*Continued from page 31*)

On the basis of data recorded, it is concluded that the form pressures computed from strain-meter observations were fairly representative of actual form pressures as produced by aggregate, water, and grout. It is further concluded that form pressures produced by grout in a mass of aggregate under conditions such as existed at Barker Dam are small in amount regardless of the rate of grouting—which, during the latter part of the work at Barker, was sufficient to increase the grout level about 30 ft a day.

When it is considered that under the low-temperature conditions at Barker the grout remained a plastic material for a period of not less than 24 hours and therefore might by itself be expected to create full liquid pressure for this period of time, it appears that the laws governing lateral pressures of freshly grouted aggregate masses are at variance with those which apply to the grout alone.

Temperatures of Prepakt Concrete

During the period of grouting, the temperature of the water in the reservoir was about 43 deg F. Except near the top of the dam and above the level of the water in the reservoir, the recorded temperature of the water in the Prepakt aggregate above the grouting zone was substantially the same as that of the water in the reservoir.

As the grout level rose there was a tendency toward gradual increase in the temperature of the water and grout at the contact surface until, at the location of Meter 17, about 106 ft above base of dam, its temperature was 13 deg F higher than that of the water above. At this level the layer of warmer water above the grout was found to be about 2 ft deep. Above this layer the temperature of the water in the aggregate mass was the same as that of the water in the reservoir.

For the grouting operation above the level of Meter 17, cold water from the reservoir was pumped down into the aggregate mass through inspection pipes, with points of discharge 5 ft above the grout level. This procedure reduced the temperature of the water at and near the grout contact surface.

The average temperature of the grout as it was pumped through the supply line was 57 deg F. The initial temperature of the grout immediately after intrusion into the aggregate mass varied from 46 deg F near the bottom of the addition, to 56 deg F at the location of Meter 17. Had cooling water been supplied so as to replace the layer of warm water which gradually increased in temperature just above the grout contact surface—as provided by the specifications and as was done above the level of Meter 17—it seems evident that the initial temperature of the Prepakt concrete could have been maintained within 5 deg F of that of the water in the reservoir throughout the complete height of the addition.

As the cement hydrated, the temperatures in the Prepakt concrete increased to a maximum which, for the thick section of the addition usually occurred about four days after grouting, and for the thin section about two days after grouting. The maximum temperature rise due to the hydration of the cement was about 18 deg F in the thick section and about 9 deg F in the thin section.

For the thick section, the average maximum temperature was about 63 deg F, and temperatures after reaching the maximum declined at the rate of about 1 deg F a day.

Three weeks after grouting, the temperatures of the mass had declined to an average of about 50 deg F. Since, under the low temperature conditions of hardening, the Prepakt concrete was of low strength at this age, and plastic flow could readily take place under very low tensile stresses, it may be presumed that during the later stages of hardening all portions of the addition below the level of the water in the reservoir were substantially free of thermal stress.

Conclusions Gained from Experience

In light of the experience gained at Barker, some of the practices there employed would be modified on future work of like character. On a large job it is believed that economies could be effected by using precast slabs of much larger size. With heavy equipment, slabs of perhaps four times the area could be handled without difficulty; and they could be placed in position at about the same rate as the smaller slabs. The total length of joints between slabs would of course be correspondingly reduced, and the cost of slab placement and joint taping and grouting would become a comparatively small item.

The quality of the work at Barker is considered excellent. It is believed that the objectives of the rehabilitation program have been completely realized in that a structure has been produced which for all practical purposes is the equivalent of a new dam, the useful life of which should be long.

With some modifications, the methods employed at Barker—using high-strength weather-resistant precast slabs for the upstream and downstream faces and Prepakt concrete of low cement content for the interior of the mass—hold promise for the construction of new dams.

Court Denies Recovery of Increased Dredging Costs

(*Continued from page 39*)

as to the character of the work but despite this the Court decided in favor of the contractor. During the hearing of this case it was testified that the data given pointed plainly, when read by an informed person, to the possibility of rock on the site. The Court commented on this testimony as follows: "We think this was wisdom after the event. It is charitable to conclude, and we do conclude without resorting to charity, that the persons who prepared the drawing and notes for defendant did not anticipate rock excavation. If we are wrong about this, and these persons did read the notes as indicating rock, they set a trap for the bidders and caught plaintiff."

An Example of Protection for Contractors

Some twenty years ago the Bureau of Yards and Docks of the Navy Department became aware that "Article 4" was not accomplishing its presumed purpose—that of providing for equitable adjustments when subsurface conditions occurred which could not reasonably have been anticipated from the information furnished bidders. The Bureau therefore decided that public policy as well as the self-respect of the engineering profession made it desirable for contracting agencies to assume a part of the responsibility for subsurface conditions which were not indicated by the information available to bidders. The Bureau thereupon began, and has since continued, the policy of inserting the following paragraph in its specifications for work involving excavation:

"*Elevations and Obstructions.* Bids shall be based on the following: (*a*) that the surface elevations are as indicated; (*b*) that rock will not be encountered (or, that rock will be encountered as indicated); and, (*c*) that no pipes or other artificial obstructions, except those indicated, will be encountered. In case the actual conditions differ from those

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stated or shown an adjustment in the contract price will be made."

In work which includes piling the Bureau has also, where practicable, specified the lengths of the piles on which bids are to be based with a provision for an adjustment in price for variations from such lengths.

Whether or not this policy has resulted in a direct saving of money can only be conjectured. It certainly has impressed contractors with its fairness and has reduced the probability of inexperienced or reckless concerns' underbidding their more cautious competitors by "taking a chance" which might result in delay, poor work, and litigation.

Subsurface Exploration Prior to Airport Expansion

(*Continued from page 46*)
subsurface strata. A 60-ft casing was left in place for use as a benchmark in these observations.

Area Brought to Uniform Grade

The fill was made by end-dumping to raise ditches and low areas and bring the site to fairly uniform grade. Then the remainder of the fill was placed in increments of 1 ft in loose thickness over the entire area and each 1-ft layer was compacted by six passes of a D-8 Caterpillar tractor or equivalent. Under paved areas, distribution of the wheel loads to be expected required a minimum of 6 ft of selected fill material, consisting of sand and gravel at natural moisture content containing a maximum of 10 percent fines.

As a further precaution against concentrated loads, all side slopes were limited to a grade of 10 to 1. Temporary drainage in the terminal area for the first stage of construction, to be replaced later by a permanent system, consisted of open channels and culverts emptying into existing drainage channels.

This method of constructing the fill makes it probable that the major portion of settlement and consolidation will take place within six months after completion of the overload fill. Some settlement thereafter is expected, but the rate will be considerably reduced and it should be uniform enough not to damage materially any pavement placed on the fill Therefore it is estimated that after a settlement period of nine months, that part of the overload fill that remains above the subgrade may be removed and pavement constructed.

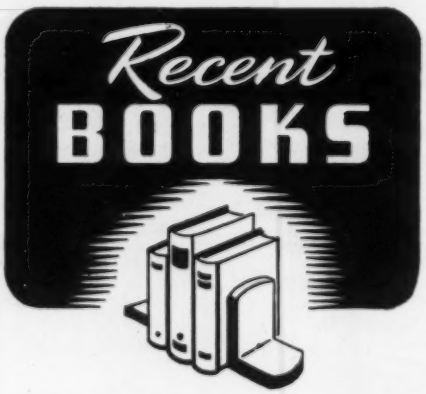
Engineering Administration of Marshall Plan Urged in Address

(*Continued from page 25*)
tions as well as the national welfare by lending some of their engineers and production experts to the administrators of the European Recovery Program for duty abroad. I would suggest that a plan be worked out whereby the private organizations would continue to pay the salaries of their engineers, with the government perhaps supplementing their income and certainly bearing their expenses abroad.

"It is my conviction that engineers can walk firmly in where politicians fear to tread. I believe that is particularly true of the job of getting Europe's factories back to production. I believe that a capable corps of American engineers working with the engineers of the various nations of Europe could do more than any other group of men to insure that the funds and goods granted under the Marshall Plan are not wasted. I believe th the cost to government of supporti these engineers abroad would be r paid a hundredfold by the savings an increased efficiencies they would normally achieve. Their monthl work reports would tell us more th an army of political supervisors.

"The engineers who go abroad w be giving practical substance to o of the major themes of the industri revolution. That theme is that wh large regions of the earth or importa segments of the population a equipped to produce more efficientl the result is not a falling off but a increase of trade for all. You kno perhaps better than any other grou that this technological civilization o ours is inherently dynamic and ex panding.

"American industry will do itse and the nation a good turn by doing a in its power to restore the well-bei of nations which have long been o best customers and are still our be friends."



JACOB INTEGRAPH INSTRUCTIONS AND TYPICAL PROBLEMS. By B. C. Jacob, 205 North Mountain St., Bay City, Mich.; photo offset by Polygraphic Co. of America, New York, 1947. 126 pp., diagrs. charts, tables, 8¼×6 in., paper, apply to author. The Jacob Integraph is a small transparent triangle having ruled lines and small perforated holes so placed as to make it possible to perform graphically a variety of arithmetical and analytical computations. It may be used with an ordinary T-square or triangle or as an attachment on a universal drafting machine. The accompanying instruction book gives a detailed explanation: first, of the simple fundamental operations; and then, of more complex problems in mechanics and engineering, including a variety of practical applications such as determining bending moments and deflections in beams and shafts, impact or collision values, forces and accelerations, volumes of tanks, etc.

SOIL MECHANICS, ITS PRINCIPLES AND STRUCTURAL APPLICATIONS. By D. P. Krynine. 2 ed. McGraw-Hill Book Co., New York and London, 1947. 511 pp., illus., diagrs., charts, tables, 9×5½ in., cloth, $5.50. Presents the principles used in the design, construction and maintenance of foundations of structures, and of structures made of earth material. The engineering applications of these principles are discussed, field and laboratory soil investigations are described, and the settlement of structures, its causes, prevention, and damage are considered. This revised edition brings both the material and the bibliography up to date and includes new sections on highway and runway subgrade.

TABLES OF SPHERICAL BESSEL FUNCTION, PREPARED BY THE MATHEMATICAL TABLES PROJECT, National Bureau of Standards, Vol. II. Columbia University Press, New York, 1947. 328 pp., tables, 10³/₄×7³/₄ in., cloth, $7.50. The major part of the present volume is devoted to tables of the spherical Bessel functions $\sqrt{\pi/2x}\,J_{\pm p}(x)$, $\pm p$ ranging from $^{29}/_{2}$ to $^{41}/_{2}$ with from 7 to significant figures. This set of tables comp ments those previously published for $\pm p$ ran ing from $^{1}/_{2}$ to $^{27}/_{2}$. A discussion of the propert of these functions and the computation meth used also appeared in the previous volume, wh both volumes contain interpolation methods a notes on their respective tables.

TECHNOLOGY OF INDUSTRIAL FIRE AND EXPLOSI HAZARDS. 2 vols. By R. C. Smart. Chapm & Hall, Ltd., London, 1947. Illus., diagr charts, tables, 8³/₄×5¹/₂ in., cloth, Vol. I, 3 pp.; Vol. 2, 184 pp., 16s each vol. The broa coverage of these two volumes should make the of interest in a wide field of industrial and i surance work. Fire wastage and research a dealt with in Vol. I, as well as the thermal pro tions of materials and fire risks with agricultu products, coal, industrial fuels, and gas Hazards with light alloys, light alloy dust e plosions, and explosive dusts produced in indust are considered. New materials, techniques an processes are discussed in Vol. II. Dangers d to toxic gases and the use of self-contained breath ing apparatus are examined, while electrical fire and explosions, due to static electricity an lightning are given close attention. Examples actual fires and explosions are given throughou the book.

THEORY AND DESIGN OF CYLINDRICAL SHE STRUCTURES (Modern Building Technique Bulletin No. 1). By R. S. Jenkins. The O. A Arup Group of Consulting Engineers, Colquhou House, London, W.1, May 1947. 75 pp., diagr tables, 9½×7 in., paper, 21s. In addition to thorough treatment of the design of reinforce concrete cylindrical shell structures, this publica tion demonstrates the use of matrix calculus a development in the analytical methods for stru tures in general. The theoretical treatment based on Jenkins' equation which enables th designer to deal with unevenly distributed pre sures and temperature changes, thus allowing t actual calculations of moments, etc., former dealt with arbitrarily. This is the first of a seri of bulletins intended to further the exchange information concerning the science of building

WATERBURY'S VEST-POCKET HANDBOOK OF ELE NEERING, 4 ed., revised by H. W. Reddick an others. John Wiley & Sons, New York; Chap man & Hall, Ltd., London, 1947. 386 pp diagrs., tables, 5½×3 in., fabrikoid, $2. This practical pocketbook provides mathemati engineering data under the headings of algebr trigonometry, mensuration, analytic geometry differential and integral calculus, theoretic mechanics, mechanics of materials, fluid me chanics, heat engineering, and electrical engi neering. New sections added in this edition cov illumination engineering and radio-electron formulas. Besides the revised tables from th previous edition, the book contains additio ones on the properties of saturated water an steam.

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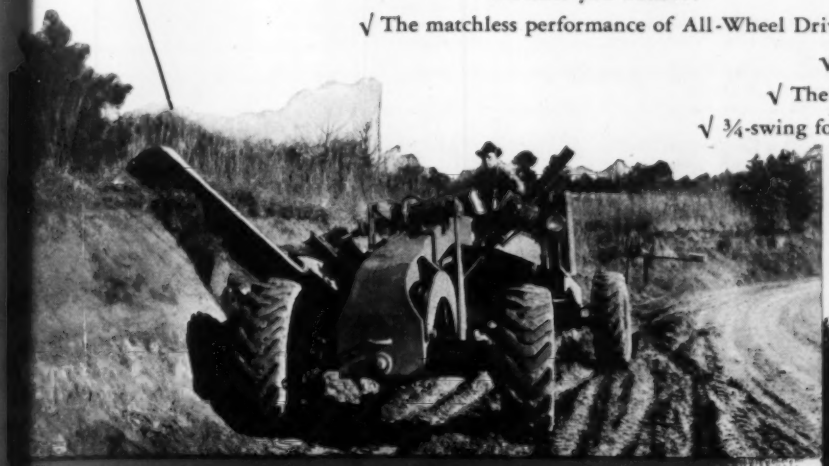

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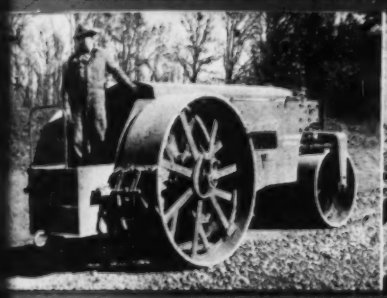

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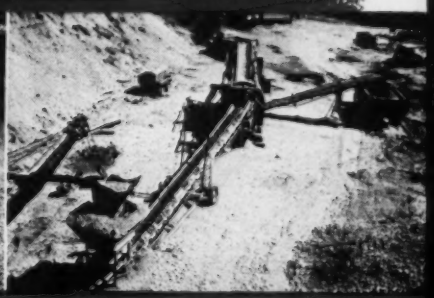

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APPLICATIONS FOR ADMISSION OR TRANSFER

February 1, 1948 Number 2

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

APPLYING FOR MEMBER

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BOSCH, HERBERT MICHAEL (Age 40) Chf., Sec. of Environmental Sanitation, Minnesota Dept. of Health, Minneapolis, Minn.

BUECHELER, WILLIAM GOTTLOB (Assoc. M.) (Age 53) Civ. Engr., Reynolds, Smith & Hills, Jacksonville, Fla.

DOUGLAS, JIM (Age 53) Dist. Engr., Texas Highway Dept., Houston, Tex.

EARLE, RALPH (Assoc. M.) (Age 44) Pres. and Treas., Thomas Earle & Sons, Inc., Jenkintown, Pa.

ECKBERG, ADRIAN EMMANUEL (Age 46) Structural and Hydr. Engr., Chas. T. Main, Inc., Boston, Mass.

FLORAS, CHRISTOS LAZARE (Assoc. M.) (Age 42) Prof. of San. Eng. and Acting Director, Athens School of Hygiene, Athens, Greece.

FOSTER, JOHNSON LEON (Age 44) Chf., Bldgs. & Structures Sec., Engr. Office, 3d Army Hdq., Atlanta, Ga.

FREGOSI, ALBERT (Assoc. M.) (Age 39), Chf., Procurement Div., Mil. Govt. Sec., Hq. 8th Army, San Francisco, Calif.

FRUHAUF, BEDRICH (Assoc. M.) (Age 41) Cons. Engr., New York City.

GEBHARD, IRVIN LLOYD (Age 49) Project Mgr., Western Contr. Corp., Modesto, Calif.

HARDING, ROBERT GEORGE (Assoc. M.) (Age 52) Cons. Engr., Salt Lake City, Utah.

HARDY, ABBY WOLVERTON (Assoc. M.) (Age 55) Aerial Photogrammetric Engr., Arkansas Highway Comm., Magnolia, Ark.

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HESS, IRVING CHENEY (Assoc. M.) (Age 67) Div. Engr., California Water & Telephone Co., San Diego Bay Div., National City, Calif.

HEWETT, MAURICE WILLIAM (Assoc. M.) (Age 57) Traffic Engr., City of St. Paul, Minn.

HILBORN, HOWARD DAVISON (Age 60) Chf. Engr., Structural Div., Emsco Derrick & Equipment Co., Houston, Tex.

HUNGERFORD, CLARK (Age 48) Pres., St. Louis–San Francisco Ry. Co., St. Louis, Mo.

JONES, DUDLEY HARWOOD (Assoc. M.) (Age 56) Prin. Engr., Geo. G. Toler Eng. Co., Ada, Okla.

KALINSKE, ANTON ADAM (Assoc. M.) (Age 36) Chf. Hydr. Engr., Infilco, Inc., Chicago, Ill.

KINI, SHRINIVAS MADHAV (Age 40) Cons. Civ. Engr., and Proprietor, M/s S. M. Kini & Co., Archts. and Engrs., Bombay, India.

KLEIN, ALEXANDER (Assoc. M.) (Age 45) Senior Engr., Research Engr., Univ. of California Eng. Materials Laboratory, Berkeley, Calif.

LARSON, EDWARD GUSTAF (Assoc. M.) (Age 56) 1946 to 1947 Gen. Supt., F. H. McGraw & Co. of East Indies, New Guinea; no current job listed; Schenectady, N. Y.

MAAHS, ARTHUR JOHN (Age 49) Chf. Engr., Johns-Manville Sales Corp., New York City.

MATTHEWS, ALFRED RAGNER (Age 43) Major, Corps of Engr., Hq. 2d Engr. Constr. Group, Care, P. M., San Francisco, Calif.

MOSCOVITZ, PAUL (Age 40) Asst. Mgr. and Chf. Engr., Palestine Water Co,, Ltd., and Palestine Mortgage & Savings Bank, Ltd., subsidiaries of Palestine Economic Corp. of New York, Tel Aviv, Palestine.

NEFF, THOMAS O'NEIL (Age 38) Asst. Prof., Mech. and Industrial Eng. Dept., Univ. of Florida, Gainesville, Fla.

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PHENEGER, BURT EASTY (Age 63) Mgr. of Operations, Duluth Dist., American Steel & Wire Co., Duluth, Minn.

PROKOPP, EDWARD JOSEPH (Jun.) (Age 35) Chf. Engr., J. L. Peters Co., Detroit, Mich.

SERVIS, LESTER WILLIAM (Age 42) Member of firm, Servis & Van Doran, Cons. Engrs., Hays, Kans.

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WALLACE, GEORGE CURTIS (Age 41) Engr. in Chg., Div. of Sewers, City and County of Honolulu, Hawaii.

WEISS, BURRAGE A. (Assoc. M.) (Age 44) Asst. Executive Supt., Imperial Irrigation Dist., Imperial, Calif.

WETTER, GIORGIO (Age 44) Designing Engr. (private practice); Associate Director, Montecatini Milano, Milan, Italy.

WILBURN, LYMAN DWIGHT (Assoc. M.) (Age 47) Chf. Engr., Morrison-Knudsen Co., Inc., Boise, Idaho.

WILEY, TARLEY TARSON (Assoc. M.) (Age 39) Asst. City Traffic Engr., Detroit, Mich.

APPLYING FOR ASSOCIATE MEMBER

BADRINATH, SRINIVAS KESAVA (Age 39) Asst. Div. Engr., H.E.H., The Nizam's Well Sinking Sec., Local Self Govt. Dept., Hyderabad State, India.

BANTON, PEMBROKE CLAYTON (Age 31) 1947 BSCE, Iowa State Coll.; previously Civ. Engr., Office Eng. Div., The Panama Canal.

BERRY, RICHARD NATHANIEL (Age 32) Gen. Mgr., Bay State Constrs. & Erectors, Inc., Malden, Mass.

BOGERT, IVAN LATHROP (Age 29) Eng. Designer, Bogert Childs Eng. Association, New York City.

BOOK, JOSEPH EMANUEL (Jun.) (Age 34) Jun. Engr., U.S. Corps of Engrs., Baltimore, Md.

CARMANY, ROBERT MUIR (Age 41) Associate Physical Testing Engr., State Highway Laboratory, Sacramento, Calif.

COLE, CHARLES WHITMORE, JR. (Jun.) (Age 32) Chas. W. Cole & Son, Engrs. and Archts., South Bend, Ind.

COOK, ROBERT PERRY (Age 31) Hydr. Engr., Asst. Chief of Hydraulics and Hydrology Sec., South Pacific Div., Corps of Engrs., Oakland, Calif.

COX, GEORGE WALTER (Jun.) (Age 35) Constr. Engr., Fordyce Gravel Co., San Antonio, Tex.

CRANDELL, HENRY ALTON (Age 54) Commr. of Streets & Sewers, Kansas City, Mo.

CURRY, JOHN JOSEPH (Age 33) Senior San. Engr., Connecticut Water Comm., Milford, Conn.

CURTIS, RUSSELL GREILICK (Age 49) Associate Engr., U.S. Engr. Office, Little Rock Dist., Little Rock, Ark.

DAVIS, GRANT LIVINGSTON (Jun.) Owner, Grant L. Davis, Civ. Engr.; also, City Engr., Dover, N.H.

DAVIS, THENTON LOWELL (Age 43) Chf. Draftsman, Sinclair Refining Co., Southeastern Dist., Atlanta, Ga.

DECAROLIS, FRED (Age 39) Jun. Engr., Chf. of Party, Triborough Bridge Authority, New York City.

D'ERRICO, THOMAS RICHARD (Jun.) (Age 30) Instructor in Mech Eng., Clarkson Coll. of Technology, Potsdam, N.Y.

DELK, FLOYD MCLEAN (Age 46) Senior Res. Engr., Houston Urban Expressway, State Highway Dept., Houston, Tex.

DYKTOR, ROBERT GUSTAVE (Jun.) (Age 27) Engr. Supervisor, Marketing Dept., Creole Petroleum Corp., Caracas, Venezuela.

GAIROLA, SHASHI SHEKHRANAND (Age 44) Post-graduate student in Eng., Univ. of Tennessee (on leave from duties as Asst. Prof., Mech. Eng., Hindu Univ., India), Knoxville, Tenn.

GENSEL, LLOYD (Age 50) Superv. Archt., Public Buildings Administration, Atlanta Div., Decatur, Ga.

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HANNON, LUCIUS, JR. (Age 29) Structural Designer, E. M. Freeman & Associates, Shreveport, La.

HINEMAN, HOWARD RAPHAEL (Age 39) Associate Engr., being Res. Engr., Div. of Highways, Bridg Dept., Los Angeles, Calif.

HOPKINS, CHARLES DEWITT, JR. (Age 30) Head, Water Supply Forecast Unit, Weather Bureau, Portland, Ore.

HOWLAND, JAMES CHASE (Jun.) (Age 31) Member of firm, Cornell, Howland, Hayes & Merryfield, Corvallis, Ore.

IRWIN, JOHN PAULETTE (Jun.) (Age 34) Owner, Jack Irwin, Engr., Ottawa, Kans.

JANECEK, RUDOLPH JOSEPH (Age 32) Field Engr., Lago Oil & Transport Co., Ltd., Aruba, N.W.I.

JARVIS, CLARENCE BEN (Age 27) Asst. to Maj. Graham, Jr., Cons. Engr., Hollywood, Calif.

JOHNSON, ALFRED MASSEY FISHER (Jun.) (Age 35) Lt.-Col. (CAC), U.S. Army (hospitalized), Chattanooga, Tenn.

LARUE, ROBERTA (Jun.) (Age 34) Hydr. Engr., Corps of Engrs., Los Angeles Dist., Los Angeles, Calif.

LEFFEL, RALPH ERNEST (Age 34) Instructor, Civ. Eng. Dept., Univ. of Colorado, Boulder, Colo.

LEFFERTS, HORACE LEEDOM (Age 33) Structural Designer, E. I. du Pont de Nemours & Co., Wilmington, Del.

LIBUTTI, ARMANDO (Jun.) (Age 35) Bridge Supt., Granite Mill & Granite Mill Canal Bridge, Harrisville, R.I.

LOUIE, SING HON (DAVID LOUIE) (Jun.) (Age 29) Hydr. Engr., International Eng. Co., Inc., Denver, Colo.

MACOMBER, ROBERT CHARLES (Age 27) Chf. Engr., Macomber, Inc., North Canton, Ohio.

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MCCANN, EUGENE HARRISON (Age 34) Dist. Civ. Engr., Humble Oil & Refining Co., Encino, Tex.

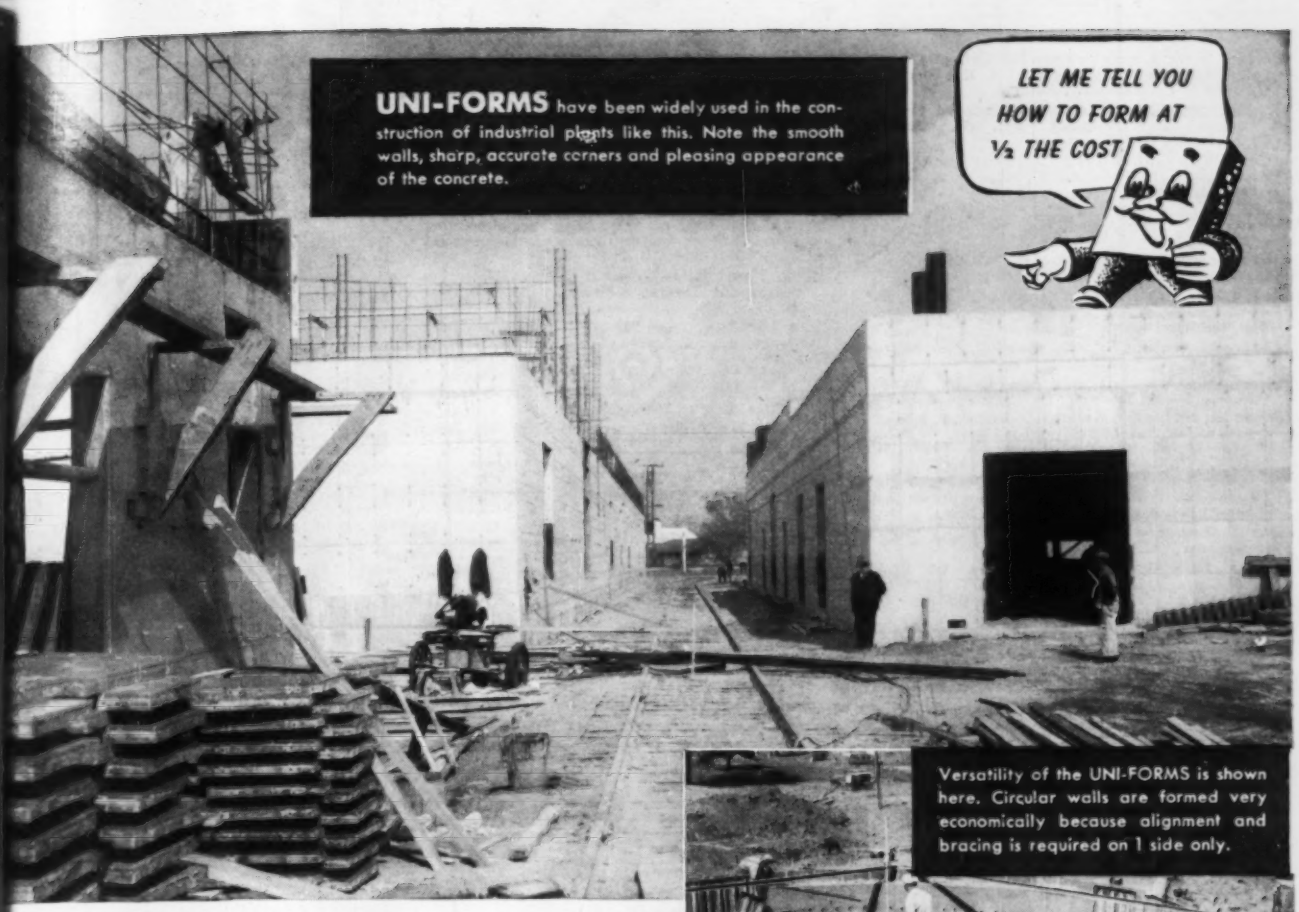
MCDILL, WILLIAM HOWARD (Age 36) Asst. Prof. of Eng., Texas Coll. of Mines & Metallurgy, El Paso, Tex.

(*Continued on page 90*)

MCNEIL, EARL KINGSLEY (Age 35) Chf. of Drain-

APPLYING FOR JUNIOR

CARPENTER, NEIL ADRIAN, 1947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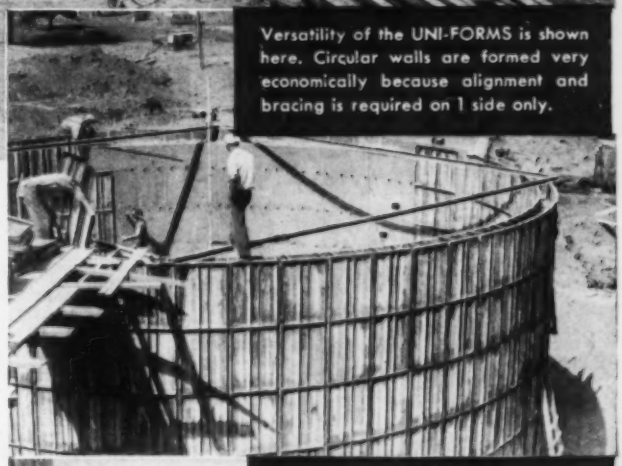
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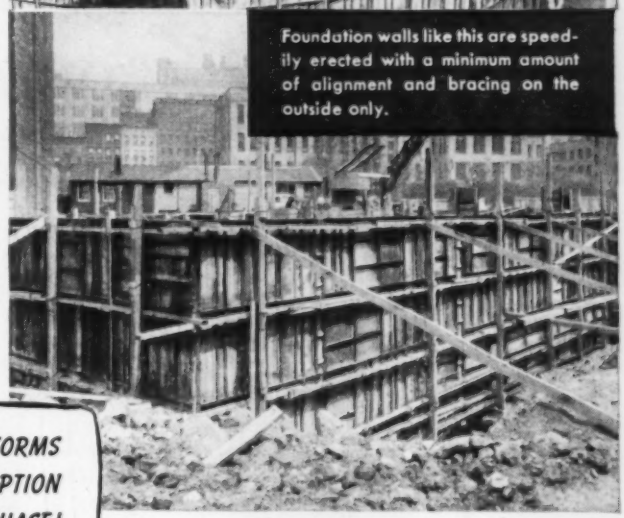

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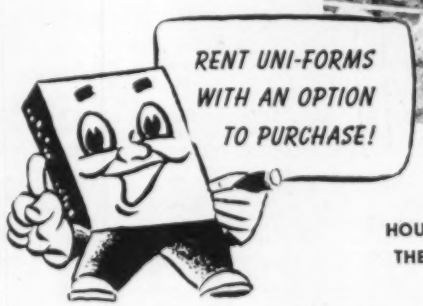

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Michel, John Field (Age 30) National Guard Instructor, Engr. Combat Bn., U.S. Army, Grand Forks, N.Dak.

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Moy, Harland Frederick (Jun.) (Age 32) Engr. Inspector, Spokane, Portland & Seattle Ry., Portland, Ore.

Murray, Raymond Arthur (Age 33) Post Engr., U.S. Army, Linden, N.J.

Neil, Patric Wilson (Jun.) (Age 34) Dist. Engr., SCS, Plainview, Tex.

Nouel C., Bernardo Augusto (Age 32) Inspector Principal, de las Obras de Ensanche del Pto. de La Guira, on construction for Frederick Snare Corp., Caracas, Venezuela.

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Reid, George Willard (Age 30) Associate Prof. of Civ. Eng., Georgia School of Technology, Atlanta, Ga.

Rice, William Thomas (Jun.) (Age 35) Supt., Potomac Yard, Richmond, Fredericksburg & Potomac R.R., Alexandria, Va.

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Storms, Richard Edward (Jun.) (Age 35) Contr.'s Engr., Walters & Prater, Inc., Norristown, Tenn.

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Zeman, Joseph Michael (Jun.) (Age 34) Cartographer, Div. of Air Navigation, Hydrographic Office, Washington, D.C.

APPLYING FOR JUNIOR

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Bremser, Lawrence William (Age 30) Designer, Black & Veatch, Kansas City, Mo.

Choudhury, Amarendra Nath Dutta (Age 27) With Corps of Engrs., U.S. Army special training in river training works, Waterways Experiment Station, Vicksburg, Miss.

Christ, Roy Henry (Age 30) Engr., Vibration Measurement Engrs., Chicago, Ill., and New York City.

Dagdelen, Oguz (Age 21) Student in Civ. Eng., Graduate School, Univ. of Illinois, Champaign, Ill.

Flor, Loy Lorenz (Age 28) San. and Cathodic Engr., Spring Valley and Lemon Grove Irrigation Dist., El Cajon, Calif.

Gonzalez Hurtado, Hernando (Age 30) Sales Mgr., Peter Snatamaria & Co., Almacen Universal, Cali, Columbia.

Herrin, William Henry (Age 26) Structural Engr., Burns & McDonnell Eng. Co., Kansas City, Mo.

Truque Gurdian, Luis Alberto (Age 24) BSCE, Univ. of Costa Rica; at present graduate student, Univ. of Illinois, Urbana, Ill.

Warnick, Calvin Cropper (Age 27) Asst. Prof. of Civ. Eng. and Research Technologist, Dept. of Civ. Eng., Univ. of Idaho, Moscow, Idaho.

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Savage, William Thomas, Jr., 1947 (23)
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CHANGES IN MEMBERSHIP GRADES

ADDITIONS, TRANSFERS, REINSTATEMENTS, AND RESIGNATIONS

(From December 10, 1947, to January 9, 1948)

Additions to Membership

Ager, John Walter Albert (Assoc. M. '47) Design Engr., Richard Costain Ltd., Dolphin Square (Res., 32 Harcourt Terrace), London S.W., England.

Aisawa, Shiro (Jun. '47) Special Research Asst., Univ. of Illinois, 207 Talbot Laboratory, Urbana, Ill.

Alspach, John Robert (Jun. '47) Plant Engr., Delos M. Palmer, Cons. Engr., 739 Nicholas Bldg. (Res., 2538 Aldringham Rd.), Toledo 6, Ohio.

Andrews, John Avery (Jun. '47) Geodetic Engr., Inter-American Geodetics Survey, Box 2031, Balboa Heights, C.Z.

Anthony, George (Assoc. M. '47) Associate Hydr. Engr., Geological Survey, Water Resources, 702 Appraiser's Bldg., San Francisco, Calif.

Autrey, William Stanley (Jun. '47) Roadway Asst., Atchison, Topeka & Santa Fe Ry., Care, J. R. Rushmer, Santa Fe Bldg., Amarillo, Tex.

Baker, Darrell Francis (Jun. '47) Graduate Student, Illinois Inst. of Tech., 3300 Federal St., Chicago 16, Ill. (Res., 1617 West Jefferson St., Boise, Idaho.)

Balasubrahmanyam, Sundaresan (Jun. '47) Supervisor, Madras Public Works Dept., Government of Madras, Madras, India; Care, U.S. Bureau of Reclamation, Federal Center, Denver, Colo.

Banks, Arthur Kelly (Jun. '47) (Banks Eng. Co.), 430 East Washington St., Charleston, W.Va.

Barentine, Elbert Hamilton (Assoc. M. '47) Surveyor, Crosby Chemical Co. (Res., P.O. Box 51), DeRidder, La.

Barnard, Edward Martin (Assoc. M. '47) Chartered Civ. Engr., "Oaklands," Wargrave Road, Twyford, Berkshire, England.

Barnes, John Patrick (Assoc. M. '47) Constr. Engr.,Senior & Palmer, Inc., 50 Church St., New York (Res., 40-20 Two Hundred twenty-first St., Bayside), N.Y.

Barnes, Merrill Eldon (Jun. '47) Instrumentman, Idaho Power Co., 13th and Bannock Sts. (Res., Route 1), Boise, Idaho.

Barrett Cecil Hewins (M. '47) Asst. Chf. Engr., Dept. of Public Works, City of Pittsburgh, 417 City County Bldg., Pittsburgh, Pa.

Baxter, Dhunjibhoy Cursetjee (M. '47) Project Officer (Govt. of India), Central Technical Power Board, "Cleremont" (Res., Care, Lloyds Bank Ltd.), Simla, India.

Beckman, Wallace Jennings (Jun. '47) Junior San. Engr., Gannett Fleming Corddry & Carpenter, 600 North 2d St., Harrisburg, Pa. (Res., 1930 Sixty-fourth St., Brooklyn 4, N.Y.)

Begley, Thomas Reid (Jun. '47) Engrs. Aide, Francis Eng. Co., Eddy Bldg. (Res., 325 Carroll St.), Saginaw, Mich.

Behrens Paul Dudley (Jun. '47) Junior Engr., Magnolia Petroleum Co., Eng. Dept., Magnolia Refinery, Beaumont (Res., 5121 Lovell, Fort Worth 7), Tex.

Bell, Willaim Hayes, Jr. (Assoc. M. '47) Archts. Supt., Albert Kahn Assoc. Archts. & Engrs. Inc., P.O. Box L, Robertson (Res., 2464 Hartland Ave., St. Louis), Mo.

Benjamin, Irwin Arthur (Jun. '47) Inst., Civ. Eng., Kansas State College, Manhattan, Kans.

Berman, Manuel (Jun. '47) Constr. Foreman, Balsam Constr. Co., State Rd. & Penarth Ave.

(*Continued on page 92*)

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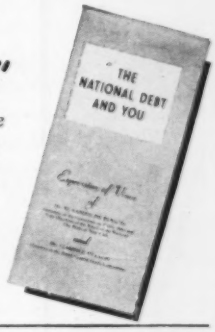

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(*Continued on page 94*)

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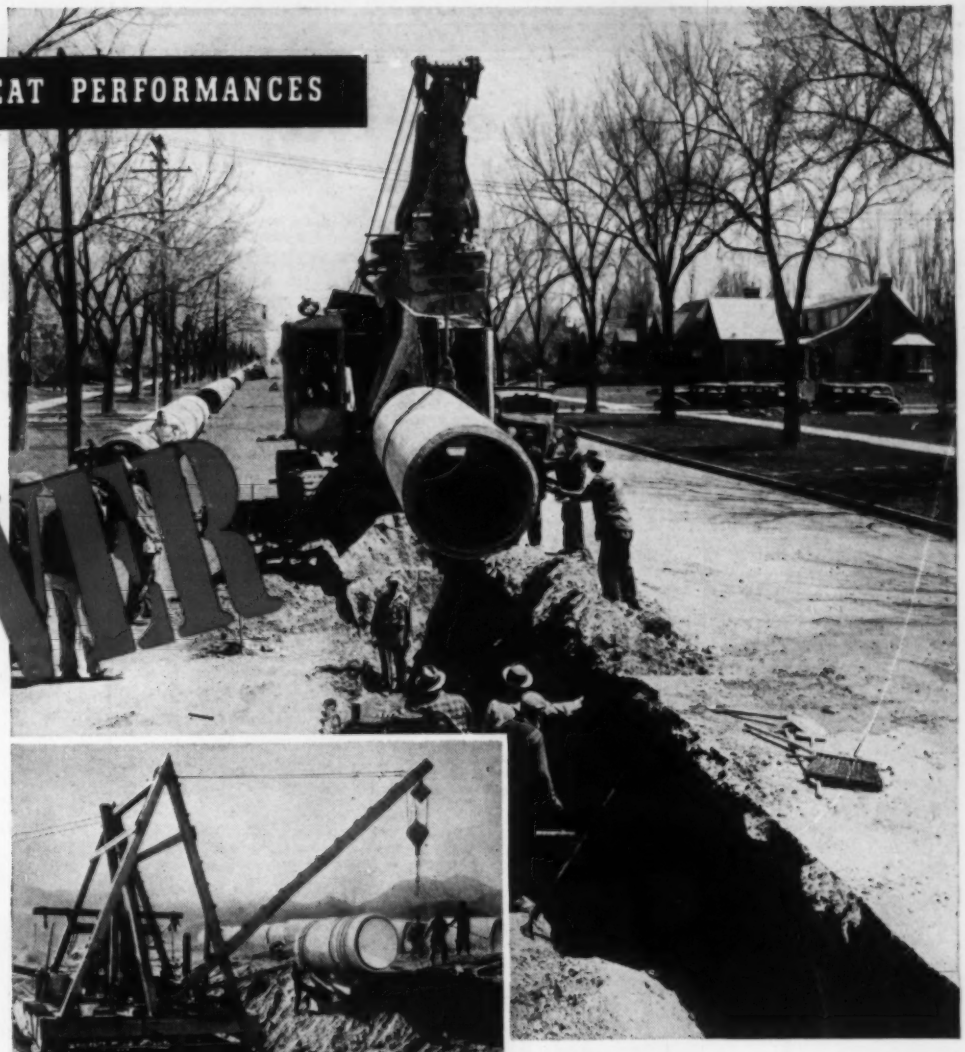

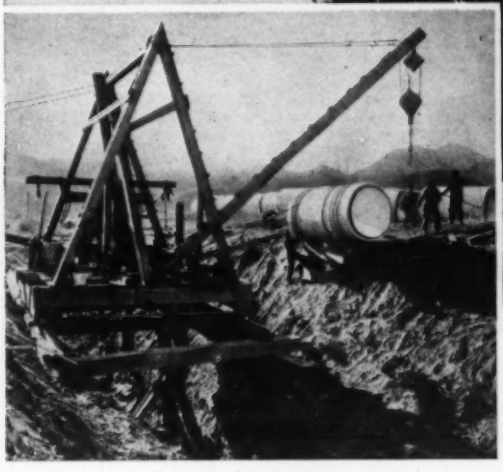

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(*Continued from page 92*)

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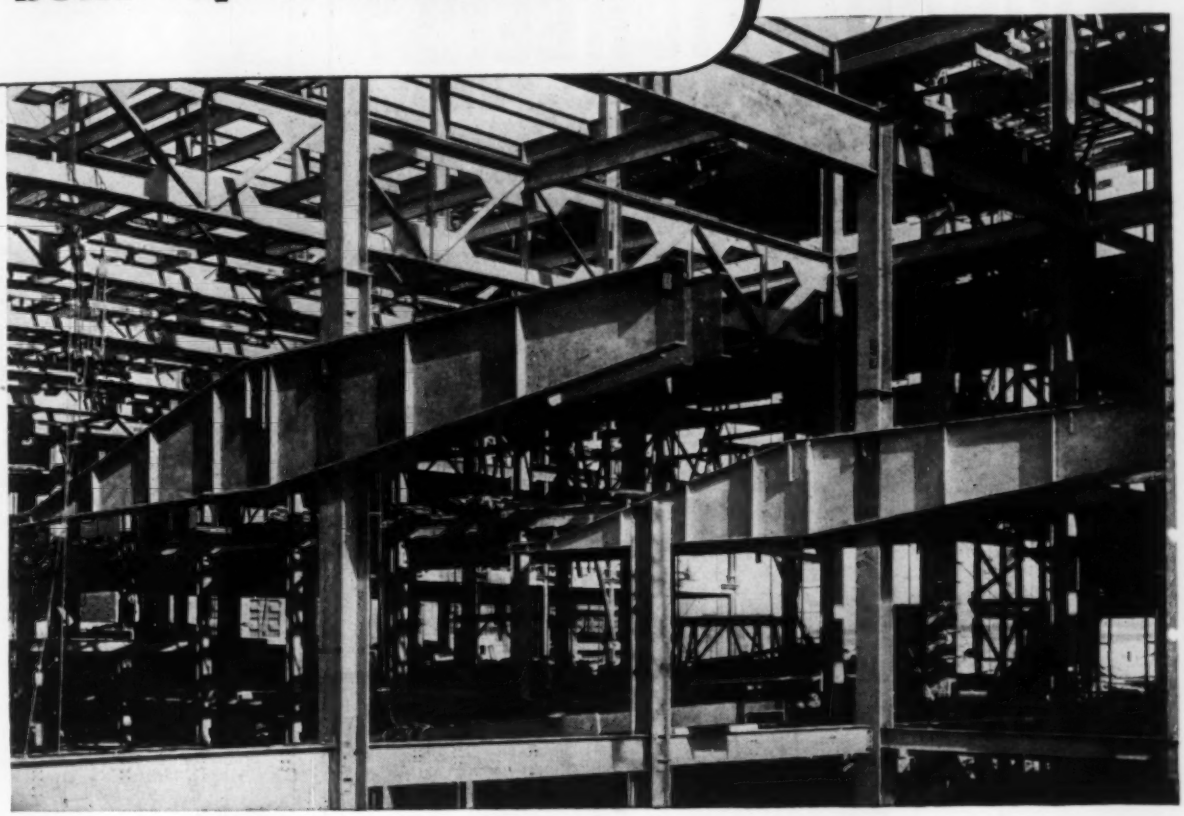

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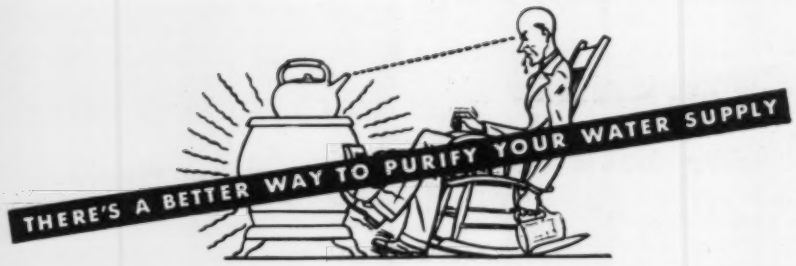

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(*Continued on page 98*)

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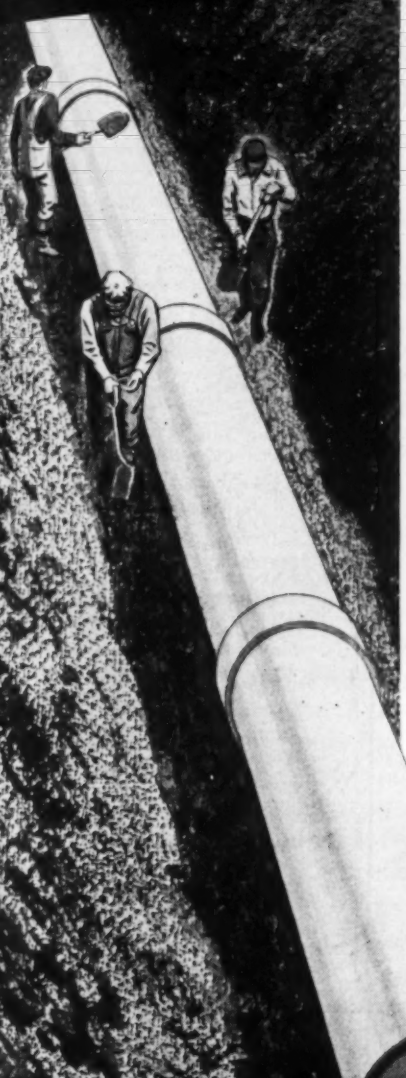

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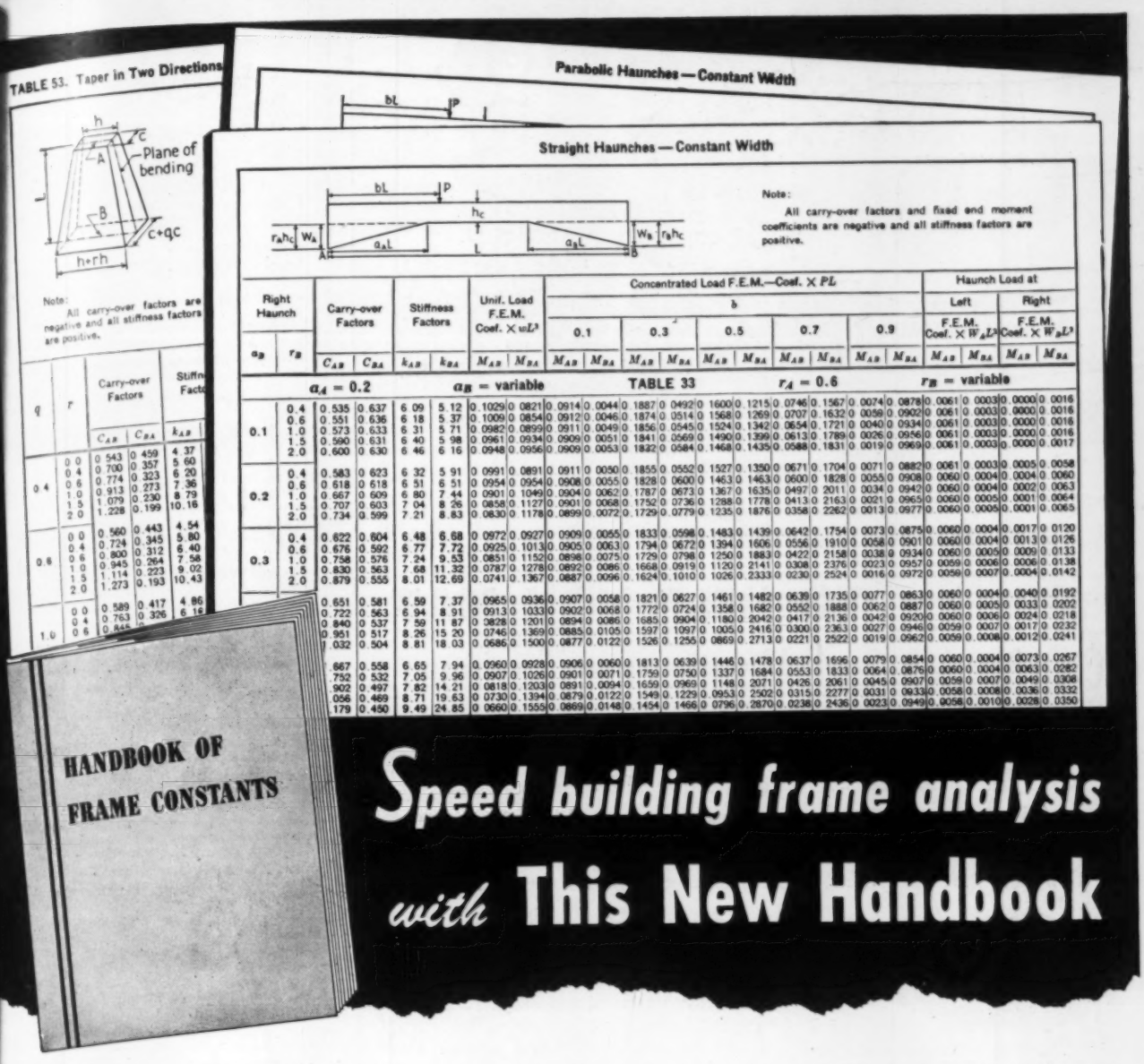
TABLE 53. Taper in Two Directions
Plane of bending
Parabolic Haunches — Constant Width
Straight Haunches — Constant Width
Note:
All carry-over factors and fixed end moment coefficients are negative and all stiffness factors are positive.
TABLE 33
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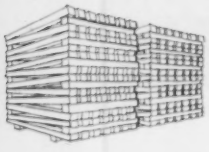

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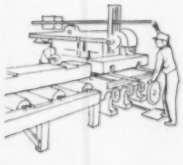

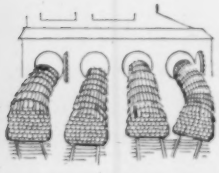

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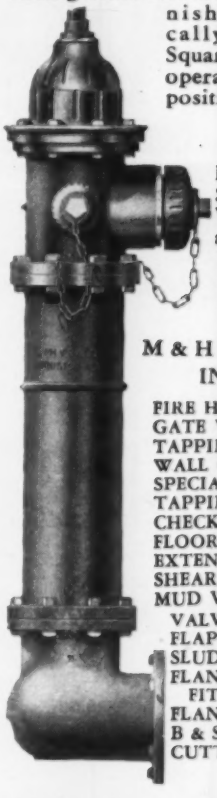

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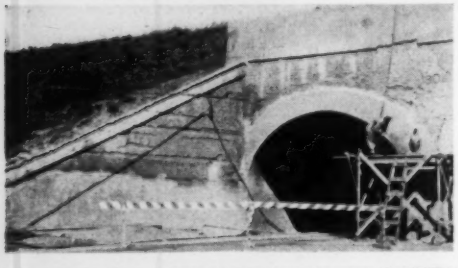

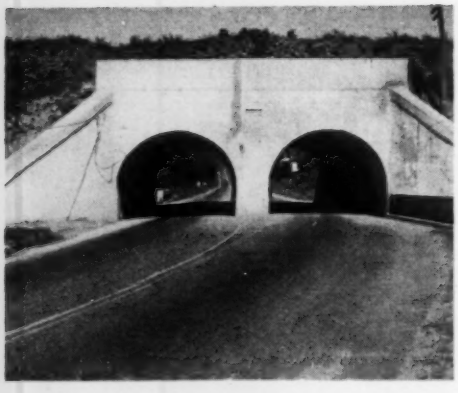

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RAMEY, JOHN KIMBROUGH (Jun. '38; Assoc. M. '47) City Engr., City of Oxford, City Hall (Res., 406 University Ave.), Oxford, Miss.

READING, THOMAS JAMES (Jun. '41; Assoc. M. '47) Materials Engr., Corps of Engrs., 10 East 17th St., Kansas City, Mo. (Res., 5831 Roeland, Merriam, Kans.)

RESCH, WILLIAM FRANK (Assoc. M. '43; M. '47) Asst. Project Supt., Bureau of Reclamation, 210 Federal Bldg. (Res., 4531 Bliss St.), El Paso, Tex.

SARAYLIOGLU, YANI (Jun. '41; Assoc. M. '47) Structural Engr., H. E. Beyster Corp., 2100 Industrial Bank Bldg., Detroit 26, Mich.

SAWYER, WILLIAM LINCOLN (Jun. '28; Assoc. M. '33; M. '47) Prof. of Civ. Eng., Univ. of Florida, Gainesville, Fla.

SCHEGOLKOV, VICTOR K. (Jun. '29; Assoc. M. '37; M. '47) Chf. Engr., Structural Dept., Isaacson Iron Works, 2917 East Marginal Way (Res., 6869 Twenty-ninth Ave., N.E.), Seattle 5, Wash.

SCOTT, HENRY CLARKSON (Assoc. M. '45; M. '47) Vice-Pres., Caldwell & Scott, Inc., 90 Broad St., New York 4, N. Y.

SHEPARD, ROBERT EASTON (Jun. '40; Assoc. M. '47) Research Associate, Univ. of Washington (Res., 1019 Terry Ave.), Seattle 4, Wash.

SIWIK, FRANCIS JOHN (Jun. 39; Assoc. M. '47) 2011 East 13th St., Brooklyn 29, N.Y.

SMITH, FREDERICK JAMES (Jun. '44; Affiliate '47) Geologist, Sinclair Prairie Oil Co., Box 99, Seminole, Okla.

SPITZER, FELIX HENRY (Assoc. M. '11; M. '47) Cons. Engr., 204 Sacramento St. (Res., 2466 Buchanan St.), San Francisco, Calif.

THOMAS, CHARLES WELDON (Jun. '34; Assoc. M. '47) Chf. Engr., Div. of Flood Control, U.S. Soil Conservation Service, 4th and Hubbard Sts. (Res., 421 Fermore St.), San Fernando, Calif.

TITUS, ERNEST MOULTON (Assoc. M. '44; M. '47) Senior Structural Engr., Tennessee Valley Authority, 217 Union Bldg. (Res., Briercliff Rd.), Knoxville, Tenn.

TOBEY, FRANK TURALL, JR. (Jun. '42; Assoc. M. '47) Structural Engr., H. B. Hunter, Cons. Engr., Porter Bldg. (Res., 3824 Morriswood), Memphis, Tenn.

VALENTE, GEORGE ANTHONY (Jun. '39; Assoc. M. '47) Const. Engr., Geo. M. Brewster & Sons, Gen. Contrs., Bogota (Res., 61 Park Ave., Caldwell), N. J.

VANONI, VITO AUGUST (Jun. '27; Assoc. M. '37; M. '47) Asst. Prof. of Hydraulics, California Inst. of Technology, 1201 E. California St., Pasadena, Calif.

VARTIA, KARL OLAVI (Jun. '37; Assoc. M. '47) Care, U.S. Bureau of Reclamation, Balmorhea, Tex.

WANNONI LANDER, LUIS (Jun. '42; Assoc. M. '47) Presidente Instituto Nacional de Obras Sanitarias, Caracas, Venezuela, S.A.

WARNER, RAYMOND ALOYSIUS (Jun. '29; Assoc. M. '36; M. '47) Civ. Engr., Wayne County Road Comm., 3800 Barlum Tower, Detroit (Res., 9840 Arden Ave., R.F.D. 5, Plymouth), Mich.

Reinstatements

BARBEAU, LIONEL MARCEL, Jun., Engr., U.S. Army Engrs., Room 603, Federal Bldg., Detroit (Res., 1528 Swansea St., Willow Run), Mich., reinstated Dec. 29, 1947.

CHAN, ALBERT JEUNG, Jun., 925 Jackson St., San Francisco, Calif., reinstated Jan. 5, 1948.

DOUGHERTY, EDWARD MONTEITH, Jun., Asst. Engr., Southern Ry. System, 101 North Gay, Knoxville, Tenn., reinstated Dec. 18, 1947.

FEIGEL, JOHN HENRY, Assoc. M., Ward A-173, U.S. Veterans Hospital, Batavia, N.Y., reinstated Dec. 29, 1947.

GARDNER, THOMAS HERBERT, M., 506 Maupas Ave., Savannah, Ga., reinstated Dec. 18, 1947.

HOLT, TAYLOR, JR., Assoc. M., Mgr., Western Office Technical Staff, The Coca-Cola Bottling Co. of Ohio, Care, The Coca-Cola Bottling Co. of California, 1340 Cypress St., Oakland, Calif., reinstated Dec. 4, 1947.

KOFMAN, MENASHAH, Assoc. M., Civ. Engr., Board of Water Supply, City of New York, 120 Wall St., New York 5, N.Y., reinstated Jan. 1, 1948.

LESHER, CARL EUGENE, JR., Assoc. M., San. Engr., H. K. Ferguson Co., Ferguson Bldg. (Res., 21535 North Park Dr.), Cleveland 16, Ohio, readmitted Nov. 17, 1947.

MILAN, ANTHONY GEORGE, Assoc. M., Care, J. S. Milan, 4645 Rokeby Rd., Baltimore 29, Md., reinstated Dec. 31, 1947.

MONARCHI, JOSEPH L., Jun., 2651 South Grant St., Denver 10, Colo., reinstated Dec. 22, 1947.

O'REILLY, THOMAS CHARLES, Assoc. M., Asst. Civ. Engr., Long Beach Water Dept., 215 West Broad-

way (Res., 1056 Walnut Ave.), Long Beach 13, Calif., readmitted Nov. 17, 1947.

ROBERTI, LOUIS, Assoc. M., Civ. Eng. Draftsman, Dept. of City Planning, Room 2530, Municipal Bldg., New York, N.Y., readmitted Nov. 17, 1947.

TANNER, WILLIAM SHERMAN, M., Asst. City Engr., City of Modesto, 715½ Tenth St., Modesto, Calif., readmitted Nov. 17, 1947.

Resignations

ATON, JAMES WILLIAM, Jun., Vice-Pres., Republic National Bank of Dallas, Dallas, Tex., resigned Dec. 31, 1947.

ADDINGTON, NORMAN, Assoc. M., Col., Supreme Commander's H.Q., E-in-C's Branch, G.H.Q., Kashmir House, New Delhi, India, resigned Dec. 31, 1947.

BOWNING, GLEN EARL, Jun., P.O. Box 1864, College Station, Tex., resigned Dec. 31, 1947.

UTLER, WILLIAM LAWRENCE, M., 123 South Broad St., Philadelphia 9, Pa., resigned Dec. 24, 1947.

CONNINGTON, CHARLES SIMPSON, Assoc. M., 490 Murray St., Pelham 65, N. Y., resigned Dec. 31, 1947.

CONRADI, HARRY, M., 17 Redcourt Ave., Armadale S.E. 3, Melbourne, Australia, resigned Dec. 31, 1947.

COREY, JOHN FREDERICK, Jun., 60 Prospect St., Newark, Ohio, resigned Dec. 30, 1947.

COWNER, JAY, M., 75 Larchmont Ave., Larchmont, N.Y., resigned Jan. 5, 1948.

ISHER, FLOYD SETH, JR., Jun., 407 Continental Oil Bldg., Denver 2, Colo., resigned Dec. 30, 1947.

EANEY, JOHN FRANCIS, JR., Jun., 31 Chase Ave., Lexington, Mass., resigned Dec. 31, 1947.

EELING, DOROTHY CROUCH (MRS.), Jun., Care, Boyle Const. Co., Sumter, S.C., resigned Jan. 5, 1948.

ERBER, HENRY JOHN, Assoc. M., 16000 Nelacrest, Cleveland 12, Ohio, resigned Dec. 31, 1947.

LURFELD, SAMUEL, Jun., 41-15 Forty-fourth St., Long Island City 4, N.Y., resigned Dec. 30, 1947.

LANDE, WALTER, Assoc. M., City Assessor, City Hall, Ann Arbor, Mich., resigned Dec. 31, 1947.

McGAUGHEY, PAUL THOMAS, Jun., 144 Mayland St., Philadelphia 44, Pa., resigned Dec. 31, 1947.

MILLER, CHARLES WALTER, Assoc. M., 2706 North Calvert St., Baltimore 18, Md., resigned Dec. 31, 1947.

MINICONE, LORENZ MAURICE, Jun., 107 North Grove St., Valley Stream, N.Y., resigned Dec. 30, 1947.

ORTOLANI, LAWRENCE, Assoc. M., Care, State Highway Dept., Road Design Development, Austin, Tex., resigned Dec. 31, 1947.

APANEK, MAXWELL CHARLES, Jun., East Chateau Apts., Woodmere, N.Y., resigned Dec. 30, 1947.

PATTERSON, THOMAS SHAFFER, Assoc. M., 609 West Fairmount Ave., State College, Pa., resigned Jan. 5, 1948.

QUENTIN, WILLIAM JOHN, Assoc. M., 2123 Eye St., N.W., Washington, D.C., resigned Dec. 31, 1947.

RICE, CLAUDE HAYES, Assoc. M., R.F.D. 2, Dover, N.H., resigned Dec. 31, 1947.

RUCKERT, WILLIAM CARL, Jun., 351 Edgewater Apt., Essex, Baltimore 21, Md., resigned Dec. 24, 1947.

RUHLING, GEORGE HUTZE, Assoc. M., 317 Marshall, East Lansing, Mich., resigned Dec. 31, 1947.

SANDS, ROBERT LAWRENCE, M., 28 Orchid St., Floral Park, N.Y., resigned Dec. 30, 1947.

SCHNEIDER, EDWIN WALLACE, Affiliate, 110 West Virgilia St., Chevy Case, Md., resigned Dec. 30, 1947.

SCHOBINGER, CHARLES WEBSTER, Jun., 558 East Gates St., Philadelphia 28, Pa., resigned Dec. 31, 1947.

STORY, JESSE WILLIS, Jun., Mountain Home, Ark., resigned Dec. 30, 1947.

TALLARICO, ALBI KIMBALL, Jun., 1917 Market St., Harrisburg, Pa., resigned Dec. 24, 1947.

TAYLOR, OLIVER GUY, M., 6313 Georgia St., Chevy Chase, Md., resigned Dec. 24, 1947.

THOMAS, CHARLES MITCHELL, M., 100 Kimball Lane, Oak Ridge, Tenn., resigned Dec. 30, 1947.

THWING, WILLIAM HAROLD, Jun., 156 Fifth Ave., New York 10, N.Y., resigned Dec. 31, 1947.

TOCHER, FRANK LAURAIN, Jun., 244-52 Ninetieth Ave., Bellerose, N.Y., resigned Jan. 5, 1948.

WACHTER, RICHARD EMIL, Assoc. M., 1200 Missouri Pacific Bldg., St. Louis 3, Mo., resigned Dec. 31, 1947.

WATTLES, HENRY STARR, III, Jun., 147 West Lanvale St., Baltimore 17, Md., resigned Dec. 31, 1947.

WHEATLEY, JOHN PAUL, Jun., Flight Test, NAS Patuxent River, Md., resigned Dec. 31, 1947.

WILLETT, ALBERT BERTRAM, Assoc. M., Sacramento, Calif., resigned Dec. 31, 1947.

WITHERELL, PAUL WALKER, Jun., 3 Bradford St., Taunton, Mass., resigned Dec. 31, 1947.

WOLF, CLEMENS WILLIAM HENRY, M., 3915 East Ashman, Route 1, Midland, Mich., resigned Dec. 31, 1947.

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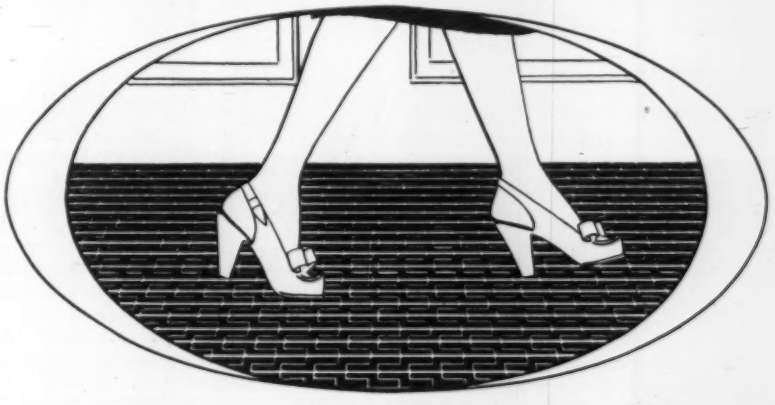

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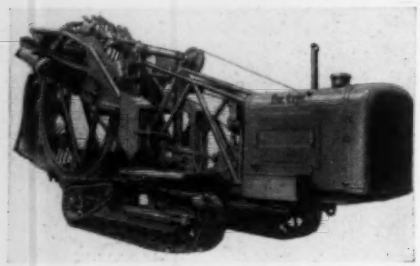
THE BUCKEYE ditcher which succeeds the Model 12 has just been placed on the market. This new ditcher, Model 312, has been subjected to field tests in actual service by contractors in various parts of the country. Compared with its predecessor, this new model is said to offer greater range, simplified controls, and better balance. It is built for longer service, faster digging, and reduced operating and maintenance costs. It cuts ditches 16 in. to 30 in. wide and up to 6 ft deep. The digging wheel is supported by a rugged frame made out of tubular members. The ditcher is several inches shorter than the old model and approximately 500 lb



lighter. A fluid coupling in conjunction with a friction clutch permits loads to be picked up or relieved with either or both. Its diesel engine develops 67 hp at 1,600 rpm. Digging speeds up to 57.5 ft per min are provided. The ditcher has four forward and four reverse road speeds. **Gar Wood Industries, Inc., Findlay Division, Findlay, Ohio.**

"Swing-Around" Loader

A NEW INVENTION designed to reduce excessive tractor costs in the heavy construction equipment field has been announced. By eliminating over fifty per cent of movement of crawler tractors, maintenance time and fuel costs are said to be cut in half with the use of the new Decker "Swing-Around" Loader. The Decker loader is designed to handle mass production loading and can be used as a shovel, bulldozer, grader, and ditcher. The bucket swings 180 deg on a circular track to permit loading one truck while a second truck is taking position on the opposite side. A complicated mechanism is not required, for power is obtained from the crawler tractor engine and applied through a simple hydraulic system. Controls are positive-acting and located within easy reach of the operator. Three complete operation cycles can be made every minute. This loader will be produced to fit several of the most popular models of crawler tractors, ranging from 1 to $2^1/_2$ cu yd buckets in size. **Decker Bros., Inc., 331 U.S. National Bank Bldg., Denver 2, Col.**

1948 Trucks

A NEW LINE of Ford trucks is being shown to the public. The streamlined 1948 trucks are said to be notable for an unprecedented range of models and capacities as well as many engineering changes. Two new series—F-7 and F-8—have maximum gross vehicle weights of 19,000 and 21,500 lb, respectively. Another new series is the six-cylinder cab-over-engine model. Three new power plants are available—a 95-hp six-cylinder engine, a 100-hp V-8, and a 145-hp V-8. Radiator grille and headlights are recessed in a functional pattern. Greater front end strength has been achieved through improved sheet-metal suspension and heavier construction. Advanced cab design provides more space and better ventilation. **Ford Motor Company, Dearborn, Mich.**

Lugger Crane

THE LUGGER CRANE is a highly versatile and mobile hydraulic unit which is said to provide exceptional utility at low cost. It lifts and carries up to 6,000 lb. Ten feet of vertical boom travel is provided with a corresponding cable travel of 16 ft. Maximum clearance under hook is 18 ft, 6 in. Sidewise movement of the boom is limited to assure stability when handling maximum loads, even with unskilled operation.

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Finishing Machine

A DIAGONAL SCREED finishing machine is being offered after eighteen months of test use on highway work. It is equipped with a transverse front screed and a pivoted rear screed which the operator can swing diagonally in either direction to operate at whatever angle best suits the work. When finishing super-elevated curves and any slab with a drainage pitch, the angle of the rear screed causes it to carry the desired amount of material uphill and compact it solidly against the higher form. This function is said to eliminate most or all of the need for carryback. Gradual adjustments of the screed angle are made without stopping as the machine approaches and leaves super-elevated curves.

An important gain is in the accuracy of surface resulting from the fact that the rear screed, operating diagonally to the front screed, always meets the material at a different point, removing high spots with a slicing action and troweling material into low spots. Diagonal screeding is credited with the ability to finish harsh mixes faster without tearing because of the fact that the rear screed works at an angle against the material left by the front screen. Both screeds have a wide range of speeds and are of the quick-crown-change type. **The Jaeger Machine Co., Columbus 16, Ohio.**

Straight Line Cutter

A LONG BEACH firm has designed a portable straight cutter which holds a welding torch and feeds it along a straight line. By turning a simple geared crank at the end, the torch travels along a predetermined line and cuts through the metal as true as if lathe-cut. Known as the C & H Straight Line Cutter, the device will hold any torch. It has an adjustable holder so the torch can be angled to cut bevel or scarf. It has a positive feed so that the operator can direct the torch as slowly or as rapidly as desired. A stainless steel wheel rolling along the work keeps the torch at a uniform distance from the work. **J. A. Campbell Co., 645 East Wardlow Road, Long Beach 7, Cal.**

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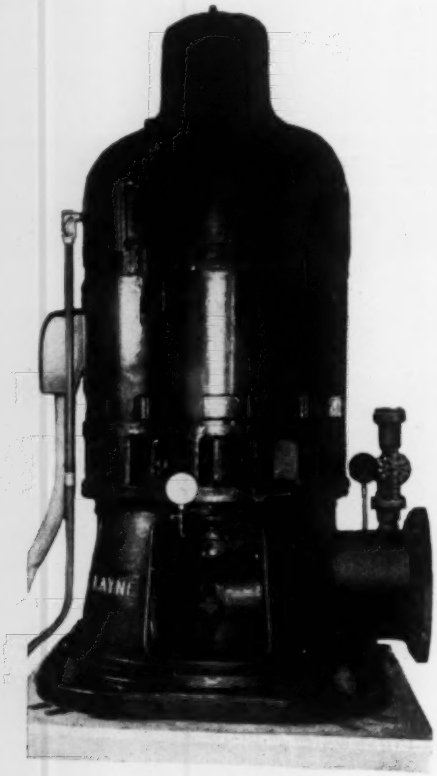

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part of the working is transferred to the rear wheels to increase traction. Push members do not interfere with steering. Front wheels will turn in normal tractor radius even when blade is in dozing position and below ground level. Blade is powered both up and down by front-mounted hydraulic pump. These bulldozers are especially recommended for backfilling, clean-up work, fast bulldozing, excavating around foundations, light stripping, aggregate handling and leveling. **American Tractor Equipment Corp., 9131 San Leandro Blvd., Oakland 3, Cal.**

Concrete Filler

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chine is a reel on which the paper cord wound. Feeding over a pulley arrangement, the cord is strung along the joint ening and forced downward by a compssing disk that packs it tightly. Since s rubber-paper combination is conered to be the ideal solution to the port runway problem, it is logical to lieve that this method can be used with great success on the highways. **E. W. itchell, Inc., Philadelphia, Pa.**

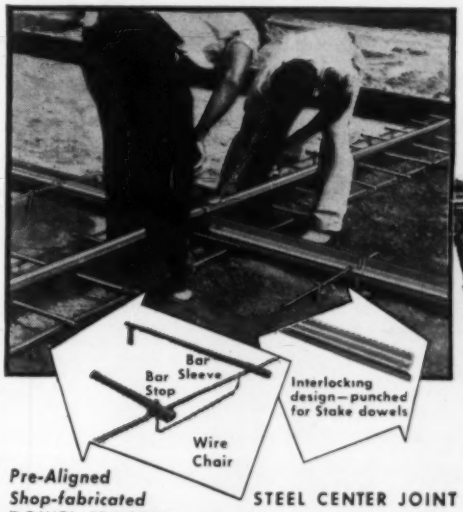
Hopper-Car

TWO NEW UNITS for facilitating the unding of stone, sand, gravel, and all bulk terials from hopper cars are announced. hese units consist of: a new type heavyty car unloader called the "358" which s a capacity range of up to three tons r minute operating in pits or above rails, d for working with the 358 is the new 363 ockpiler-loader which features many new evelopments. Unique among the many atures of the 358 unloader is its chain and lt conveyor. Chain and belt are riveted gether by means of steel attachments d cleats. Power is transmitted through ain and belt to give positive belt movent at all times. The 363 stockpilerader is completely new in design. It has stair-channel frame and simple swiveling heels make it flexible. Available with lain or cleated belts, the 363 eliminates rouble due to old-fashioned chain and procket drive through its use of V-belt rive, two precision gear reducers, and a haft drive to the head pulley. Threenit belt carriers mounted on welded steel ases through the belt and minimize belt ear. Anti-friction bearings are used hroughout. It is available in a belt width f 24 in. and in lengths of 25, 30, and 35 ft. **Barber-Greene Company, Aurora, Ill.**

Threadless Malleable Fittings

FLAGG-FLOW threadless malleable pipe ittings have just been introduced to industry. The revolutionary threadless fitting s said to simplify any piping layout and nake it possible to join steel or wrought ron pipe without threads and without welding by a brazing method any competent pipe fitter can use. Described as he first joint ever produced that opens the way to reducing the wall thickness and weight of pipe, Flagg-Flow enables the use f plain end pipe. It also affords 30 per ent less weight than the same kind and ize of threaded fitting. Designed for brazing to standard black steel or wrought ron pipe, the new fittings are currently nade in sizes up to and including 2 in. Flagg-Flow fittings are said to prove the ability of the joint to withstand much higher rates of vibration than threaded oints. The threadless malleable fittings are also of great value in confined spaces where it is difficult, or even impossible, to use a pipe wrench, in locations inaccessible for maintenance after installation, and in thin walls and partitions where ordinary, bulky fittings would be exposed, and in concrete, or cinder-fill flooring. **Stanley G. Flagg & Company, Inc., Philadelphia, Pa.**

LACLEDE STEEL REINFORCEMENTS
speed highway construction



Pre-Aligned Shop-fabricated DOWEL SPACERS

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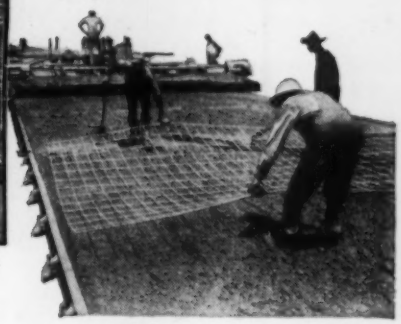
Laclede shop-fabricated dowel spacers units are position-welded and supports are preformed for automatic alignment and ease of assembly on the job without wire-tieing.



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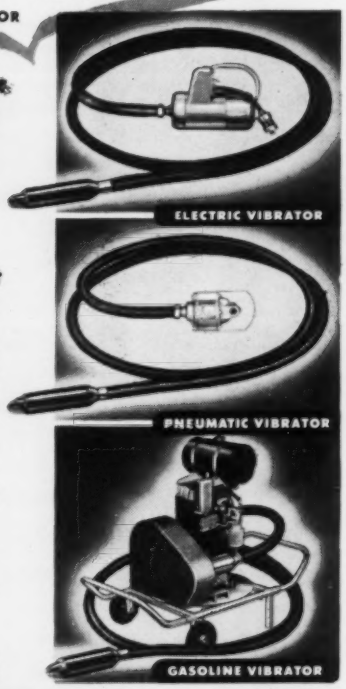

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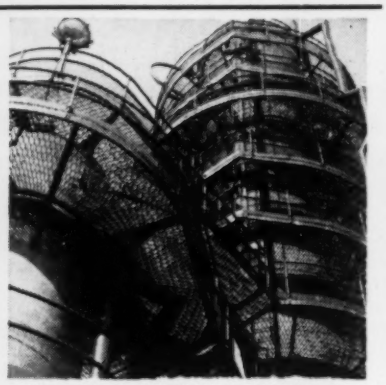

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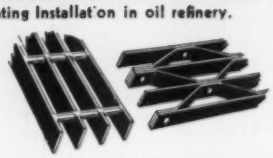

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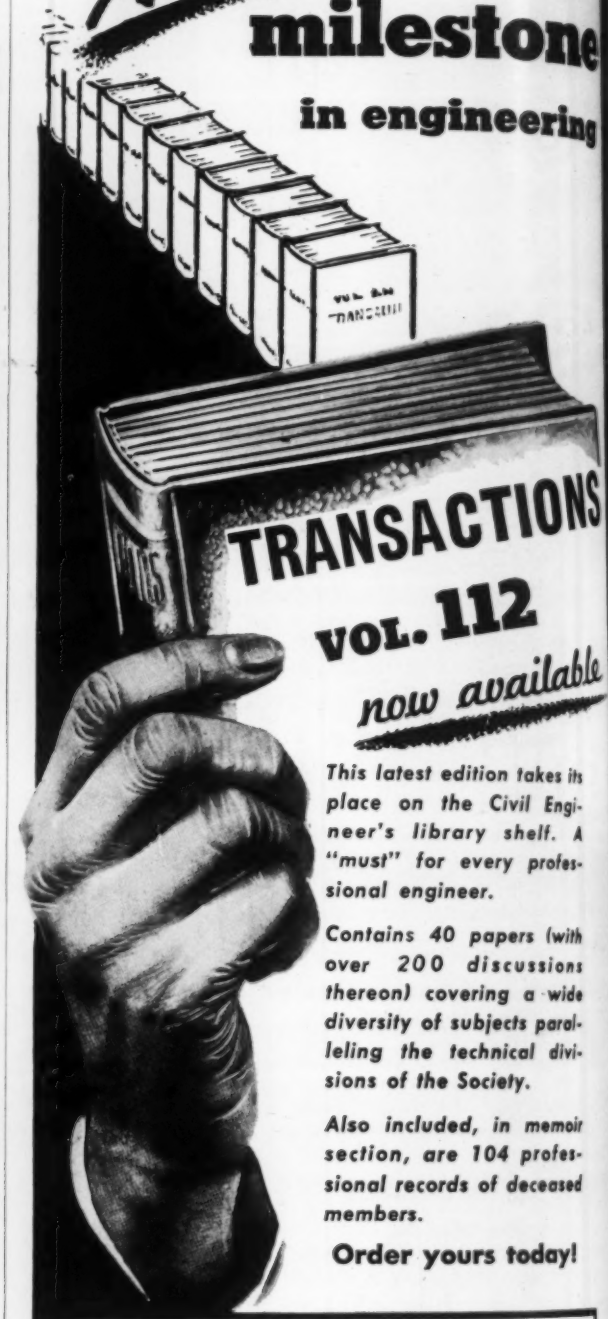

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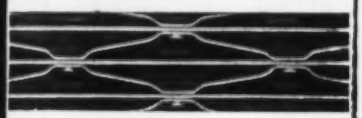

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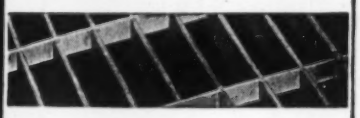

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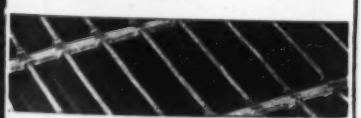

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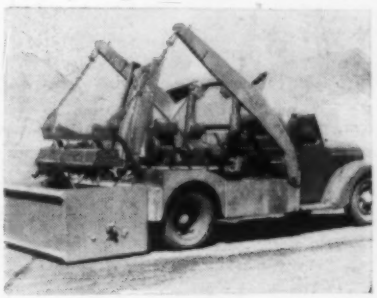

300-Ampere Generator

DELIVERIES OF A 300-amp bare welding generator are now being made by P & H. This unit has a welding service range of from 30 to 375 amp. Called the model WC-300, it is designed for easy coupling to a gasoline engine or power take-off. A V-belt pulley arrangement makes exact alignment between power and generator unnecessary, thereby simplifying the building of the welder. This model has just one control for any desired welding heat within the machine's entire range. P & H's "Visa-matic" calibration plate permits selection of the correct welding current for all classes of electrodes. **Harnischfeger Corp., Welding Division, 4400 W. National Ave., Milwaukee 14, Wis.**

Plastic Sealant

A NEW MORTAR sealant has been specially formulated for use on glass block. Known as Klee Sealant, it coats the exterior mortar joints, adheres to the mortar, and forms a tight flexible bond to the glass, expanding and contracting with the mortar as well as the glass. It is of plastic-like consistency, can be applied with a caulking gun or thinned down to brushing consistency, and can be indented with a finger nail, similar to rubber. **Research Laboratory, The American Fluresit Co., 635 Rockdale Ave., Cincinnati, Ohio.**

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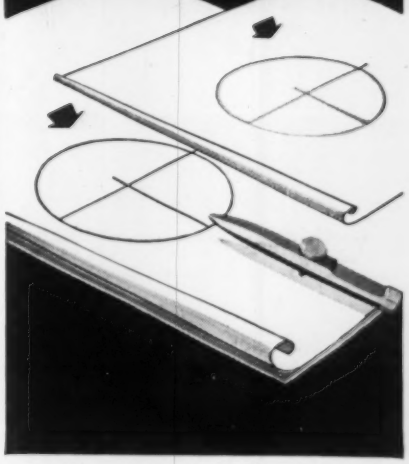

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Fig. B-68. Type M (Circular) Gate

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Literature Available

VALVE CATALOG DEBUT—A 60-page hard cover volume providing detailed description and specifications of rubber seat butterfly valves and their accessories is now available. The book, designed for engineers, emphasizes actual blueprint reproductions for reference to work in progress. The valves themselves are unique in their design and flexibility of operation. A rubber seat engages the rotating butterfly disk to provide a tight seal in low-pressure fluid service. Features included in the catalog are design of the valves, flexibility of operations, sizes, materials to suit service conditions, remote operation methods, and many others. **Henry Pratt Company, 2222 South Halsted St., Chicago 8, Ill.**

ASPHALT PLANK—A 5-page folder describing asphalt plank is now being offered. Included in the folder is an article entitled "Helicopter Landings Expand Roofing Opportunities" which tells of the use of asphalt planks as the material for roofs used for helicopter landings. Methods of laying, specifications, waterproofing qualities, and methods of application are also discussed and pictured. **Servicised Products Corp., 6051 65th St., Chicago 38, Ill.**

HYDROPLEX PUMP—Bulletin No. 47-8020 describes the Hydroplex pump, a split case multi-stage centrifugal pump for low-capacity and high-pressure pumping. The eight pages in two colors cover various views of the Hydroplex, cross-section schematic, subassemblies, parts and dimensional orthographic drawings, and also installation photographs. The Hydroplex, as described in the bulletin, is equipped with a direct-connected electric motor and its head range is 450 to 1,700 ft, and its operating speed 3,550 rpm at 60 cycles and 2,950 at 50 cycles. **Byron Jackson Co., Pump Division, Los Angeles 54, Cal.**

BATCHING PLANTS—Advantages and condensed specifications of Noble batching plants are described in four illustrated 4-page folders. A separate folder is devoted to each of four plant sizes: 80, 100, 150, and 350 tons. Plan drawings and photographs of field installations are included for each model. Special features explained include the principle of weigh batching with central cement compartment, one-man operation, portability, and flexibility of setup. **Noble Co., 1860 7th St., Oakland 7, Cal.**

NAILER JOISTS—As a simplification measure, effective June 1, 1948, the manufacture of six types of Nailer Joists—namely, Types 80W, 100W, 120W, 121W, 141W, and 161W—will be discontinued. Thereafter, all members identified with the Steel Joist Institute will manufacture only fourteen sizes of Standard Joists and fourteen sizes of Nailer Joists. A new table which supersedes the current issue of the handbook gives steel joist designation, depth resisting moment, and maximum end reaction of each of the types of joists to be manufactured. **Steel Joist Institute, 1200 Eighteenth St., N.W., Washington 6, D.C.**

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